SUGARBEET RESEARCH

1984 REPORT

A Report to and for
the Sole Use of Cooperators
NOT FOR PUBLICATION

FOREWARD

SUGARBEET RESEARCH is an annual compilation of progress reports concerning incomplete research by Agricultural Research Service investigators and cooperators who are engaged in sugarbeet variety and production research. The report has been assembled and reproduced at the expense of the Beet Sugar Development Foundation, and is for the sole use of the cooperators. Much of the data has not been sufficiently confirmed to justify general release and interpretations may be modified with additional experimentation. The report is not intended for publication and should not be used for cited reference nor quoted in publicity or advertising. Reproduction of any portion of the material contained herein will not be permitted without the specific consent of the contributor or contributors.

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Trade names occur in this report solely to provide specific information and do not signify endorsement by the U.S. Department of Agriculture or the Beet Sugar Development Foundation.

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SUGARBEET RESEARCH

1984 Report

Section A

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Cooperation:

Delta Sugar Company
Holly Sugar Corporation
Spreckels Sugar Division
Union Sugar Division
California Beet Growers Association

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ABSTRACTS OF PAPERS PUBLISHED OR APPROVED FOR PUBLICATION, 1984

FAIL, G. L., J. H. LANGENHEIM and L. L. HOEFERT. Entry, ramification and lesion production by a leaf spotting fungus on leaves of Hymenea courbaril, a tropical leguminous tree. Am. J. Bot. 71:(5):2:28. 1984.

As part of a long-term evolutionary study, we are examining possible defense mechanisms of Hymenaea leaves against fungi, which can be an acute problem in tropical ecosystems. Leaf secondary chemicals have been demonstrated to be inhibitory against a leaf-spotting fungus, Pestalotia, which occurs throughout the New World distribution of Hymenaea species. Although Pestalotia is mainly saprophytic in the temperate zone, it can be pathogenic in the tropics. The infection of leaves of Hymenaea courbaril, a widespread species, by P. subcuticularis is being examined with light and scanning electron microscopy, and histochemical techniques. The fungus enters leaves through the intact or broken cuticle. It produces lesions by intercellular ramification, possible toxin production, and cellular necrosis. There is no hyphal penetration of intact cells. Hyphal growth on leaf surfaces follows the irregular contours of the cuticle, and apparently digestion of the cuticle occurs. Progressive discoloration of the veins in advance of mycelial growth indicates that a toxin may be transported throughout the xylem. The infection process will be compared and contrasted with reports of similar infections, and the hypothesis of latent (symptomless) infection will be discussed.

HOEFERT, L. L. Beet western yellows virus in phloem of pennycress. J. Ultrastructure Res. 88:44-54. 1984.

The effects of beet western yellows virus on pennycress phloem were investigated using electron microscopy and collecting at intervals after aphid inoculation. Particles were seen in mature sieve elements from the earliest collection date, but they became less numerous in sieve elements of older leaves as the infection progressed. The first cytopathological effect in phloem parenchyma cells was the appearance of virus vesicles that became enclosed in ER membranes and attached to the outer layer of the nuclear envelope. At the time of vesicle attachment and thereafter, virions appeared in phloem parenchyma cell nuclei. In some instances virions appeared in the cytoplasm, but in many cases they remained in nuclei, often occupying a perinucleolar postion. Aspects of the virus invasion and distribution in pennycress phloem are compared to effects of other luteoviruses.

HOEFERT, L. L. and S. S. MARTIN. Developmental changes in germinating Thlaspi arvense seeds. Am. J. Bot. 71(5):2:14. 1984.

Specialized cells (idioblasts) appear to be associated with the accumulation of glucosinolates (mustard oil glucosides) in members of the Brassicaceae. Ultrastructural and biochemical studies of cotyledons of pennycress, Thlaspi arvense L., were made to provide data on changes in glucosinolate content relative to developmental changes in idioblasts. Cotyledons only were studied; radicles and hypocotyls were removed because very few idioblasts were found in them. Seeds were germinated on moist filter paper and collections were made at 1 day intervals for 7 days. Glucosinolate

concentrations were determined by gas chromatography and compared with structural changes in cells as seen with the electron microscope. Glucosinolate concentrations increased for the first days of germination. This correlated positively with changes in cell structure observed over the same period, in which cells secreted material into vacuoles, elongated intrusively, and divided and differentiated in vascular tissues. The secretory material appeared first in endoplasmic reticulum, then blebbed off as vesicles that enlarged and fused with the central vacuole of the idioblasts. The correlated ultrastructural and biochemical data permit a new interpretation of structure/function relationships of these specialized cells.

JOHNSTONE, G. R., HSING-YEH LIU, and JAMES E. DUFFUS. First report of a subterranean clover red leaf-like virus in the western hemisphere. Phytopathology 74:795. 1984.

A luteovirus closely related serologically to subterranean clover red leaf virus (SCRLV) has been found in California. SCRLV was previously reported only from Australia and New Zealand. The California virus isolates (SCRLV-C) were found from naturally infected legumes in central California and reacted in ELISA tests with antiserum to the Australian isolate of this virus but not to legume yellows virus antiserum or to beet western yellows virus antiserum. SCRLV-C virions, purified and concentrated from pea (Pisum sativum L. cv. Puget), appeared identical to those from Australia on the basis of particle morphology and serological tests. The Australian isolates of SCRLV are, however, transmitted only by Aulacorthum solani (Kalt.) whereas the California isolates are transmitted only by the pea aphid Acyrthosiphon pisum (Harris).

LARSEN, RICHARD C., JAMES E. DUFFUS, and HSING-YEH LIU. Tomato necrotic dwarf--A new type of whitefly-transmitted virus. Phytopathology 74:795. 1984.

A new whitefly-transmitted virus causing leaf necrosis and severe stunting of tomato plants has been recently isolated from the Imperial Valley, California. The infectious agent, Tomato Necrotic Dwarf Virus (TomNDV), which affects tomato, pepper, tomatillo, eggplant, and several weed hosts is transmitted by Bemisia tabaci as well as being mechanically transmitted. Purified virus has been shown to contain three distinct isometric components ca. 30 nm in diameter. Preliminary investigations of the virions by electron microscopy and spectrophotometric analysis suggest that only the middle and bottom components contain nucleic acid. The $A_{260/280}$, uncorrected for light scattering, was typically 1.0, 1.78 and 1.91 for the top, middle, and bottom components, respectively. Sedimentation coefficients ($S_{20,w}$) of the virions are 57S(T), 117S(M) and 138S(B). Tests by mechanical inoculation indicate that both middle and bottom components are required for infection.

LEWELLEN, R. T. and I. O. SKOYEN. Official release of sugarbeet germplasm C302 through C308. Nov. 19, 1984.

Monogerm, self-fertile, genetic male-sterile facilitated random mating population 755 has been the source for studies at Salinas on population improvement in sugarbeet. Based upon progeny test results at Salinas and

Brawley, individual S_1 lines that appeared to be superior for one or more traits were increased and released as germplasm lines C302 through C308.

LEWELLEN, R. T., E. D. WHITNEY, and I. O. SKOYEN. Registration of C37 (Reg. No. PL-23) sugarbeet parental line. Crop Sci. 25:375. 1985.

Line C37 that was released in 1981 is described.

LEWELLEN, R. T., I. O. SKOYEN, and E. D. WHITNEY. Registration of C46 (Reg. No. PL-24) sugarbeet parental line. Crop Sci. 25:376. 1985.

Line C46 that was released in 1982 is described.

MARTIN, S. S. and L. L. HOEFERT. A new technique for glucosinolate analysis. Phytochem. Soc. of North America Newsletter 14(2):41. 1984.

McFARLANE, J. S. Breeding for resistance to sugarbeet yellow wilt. Final Report, July 1, 1984. 37 p.

STEELE, A. E. Nematodes Parasitic on Sugarbeet. Chapter 14 in Plant and Insect Nematodes. Edited by W. R. Nickle, publ. by Marcel-Dekker, Inc., pp. 507-569. 1984.

This chapter is part of a larger textbook written for teachers, researchers and students of plant pathology and nematology. The greatest effort is on the sugarbeet nematode, Heterodera schachtii, which probably accounts for in excess of 90% of the damage to sugarbeet caused by nematodes. In addition, nematode species of seven genera of economic importance in sugarbeet and more briefly, of nematodes of lesser importance, are discussed. The chapter contains 252 literature citations, 3 tables and 38 illustrations. The text brings together the latest research findings on Heterodera schachtii and Heterodera trifolii.

STEELE, A. E. Nematodes of sugarbeet. In Compendium of Sugarbeet Diseases. Edited by E. D. Whitney and J. E. Duffus, publ. by Amer. Phytopathological Soc. (In press). 1985.

This manuscript is a section of a compendium written for phytopathologists, nematologists, teachers, students and others concerned with diseases of sugarbeets. The manuscript presents information of disease symptoms and biology and control of economically important nematodes affecting sugarbeet production. The text is supported by 23 figures which will be published in color.

STEELE, A. E. and A. M. GOLDEN. Comparisons of selected morphological characters and host ranges of Heterodera avenae and H. mani. Proc. First Internaticnal Congress of Nematology, Guelph, Ont., Canada, p. 87. 1984.

Measurements of total length, stylet length, tail length and length of the tail terminus do not appear to be useful for the separation of second-stage juveniles of H. avenae and H. mani. The two Heterodera species can be differentiated by shape of stylet knobs of second stage juveniles, the length of the vulval slit and presence or absence of an underbridge within vulval cones of cysts. The host preference of H. avenae in descending order

was: Hordeum vulgare; Triticum vulgare; T. polonicum; Avena sativa; A. fatua; Secale cereale; Lolium perenne; and Hordeum leporinum. Of these plants only L. perenne was a host for H. mani.

STEELE, A. E. Tests for nematicidal efficacy using eggs, juveniles or cysts of Heterodera schachtii. In Methods for Evaluating Chemical for Plant Disease Control. Amer. Phytopathological Soc. (In press). 1985.

This paper is a revision and update of a previous publication of the same title and published in 1978. The paper describes a number of methods for evaluating non-fumigant pesticides for control of the sugarbeet nematode, Heterodera schachtii. The tests are conducted in the laboratory, growth chamber or greenhouse. The methods described in this paper should be a valuable reference for students, teachers and researchers concerned with control of cyst-forming nematodes of agricultural importance by chemical pesticides or integrated pest management incorporating chemical treatments.

WHITNEY, E. D. Rhizomania of sugarbeet in California, U.S.A. International Institute for Sugar Beet Research. 1984.

The paper brings to the attention of European scientists the occurrence and distribution of rhizomania in California in 1983, and the similarity of the virus, fungus, symptoms and the conditions under which it effects sugarbeet in the United States and Europe. The most important aspect of the paper is the distribution of this scientific information which should stimulate cooperative research and expedite the control of rhizomania in both the United States and Europe.

WHITNEY, E. D. and R. T. LEWELLEN. Bacterial vascular necrosis and rot of sugarbeet: Effect of moisture, age of plants, injury, inoculation and genotype on susceptibility to infection. J. Amer. Soc. Sugar Beet Technol.: (In press). 1985.

Greenhouse studies suggested that for intermediately resistant sugarbeet cultivars, but not susceptible or resistant ones, the application of moisture to injured plants extended the length of time that injuries were susceptible to infection by Erwinia. This moisture effect also extended to the application of water in the field by sprinkler irrigation causing an increase in the rate of infection and rot. Six-wk-old sugarbeets were more susceptible to infection in field studies than were plants inoculated when 8 or 10 wk old. Cultivars resistant to the Erwinia pathogen produced more sugar than susceptible cultivars at each age tested. This advantage in sugar yield of resistant cultivars increased with plant age. Because the bacterium is temperature dependent, the data suggest that early planting as well as cultural practice to prevent early infection would reduce losses from Erwinia. Cultivar x inoculation x injury interactions as measured by disease index and yield were observed.

YU, M. H. Transmission of nematode resistance in the pedigree of homozygous resistant sugarbeet. Crop Sci. 24:88-91. 1984.

Transmission of resistance to the cyst nematode (Heterodera schachtii Schm.) in the pedigree of a homozygous resistant sugarbeet (Beta vulgaris L.) was further studied with the aid of a red hypocotyl marker and the male-sterile

stocks. The result indicated that virtually all megaspores and microspores produced from the resistant homozygotes carried resistance to their resultant progeny. In the succeeding generations, however, resistance transmission was less than complete, being 97.5% through eggs and 95.7% through pollen of the S_2 plants of line 3584. These rates indicate that nematode resistance may be lost from a homozygous resistant sugarbeet line, although only at low rates. For this reason, future sugarbeet hybrid cultivars developed from an early generation of a resistant homozygote may confer the highest level of nematode resistance. No close linkage between the loci for hypocotyl color and nematode resistance was detected.

PAPERS WHICH HAVE BEEN PUBLISHED SINCE BEING ABSTRACTED IN PREVIOUS SUGARBEET RESEARCH REPORT

DUFFUS, J. E., E. D. WHITNEY, R. C. LARSEN, H. Y. LIU, and R. T. LEWELLEN. First report in Western Hemisphere of Rhizomania of sugarbeet caused by beet necrotic yellow vein virus. Plant Disease 68:251. 1984.

FALK, B. W. and JAMES E. DUFFUS. Identification of small single-end double-stranded RNAs associated with severe symptoms in beet western yellows virus-infected Capsella bursa-pastoris. Phytopathology 74:1224-1229.

JOHNSTONE, G. R. and JAMES E. DUFFUS. Some luteovirus diseases in Tasmania caused by beet western yellow and subterranean clover red leaf viruses. Aust. J. Agr. Res. 35:821-830. 1984.

STEELE, A. E. and L. WHITEHAND. Comparative morphometrics of eggs and second stage juveniles of Heterodera schachtii and a race of H. trifolii parasitic on sugarbeet. J. Nematol. 16:171-177. 1984.

WHITNEY, E. D. and R. T. LEWELLEN. Registration of C35/1 and C35/2 sugarbeet germplasm. Crop Sci. 24:830. 1984.

WHITNEY, E. D. and R. T. LEWELLEN. Registration of C40 sugarbeet germplasm. Crop Sci. 24:830. 1984.

HOST RESISTANCE OBSERVED IN SOME BETA SPECIES

M. H. Yu

Host-plant resistance in the wild beet germplasm has a close relationship to the improvement of sugarbeet, Beta vulgaris L. Sugarbeet is a favored host for many insects, nematodes, fungi, bacteria, and viruses, etc. Immunity or high levels of resistance to attack from these agents is largely lacking, or inadequate, in sugarbeet. Notwithstanding, it is possible to introgress such resistance into sugarbeet from wild species within the genus Beta. Breeding high-yielding sugarbeets tends to narrow the genetic base of the primary germplasm. A cultivar developed from a narrow genetic base could be more vulnerable to an unexpected disease attack when the time comes. There is a tremendous amount of genetic diversity in wild species. Unexpected and unpredictable characteristics often appear in the progenies of hybrids between cultivated and wild forms. Incorporation of wild beet germplasm or its secondary and tertiary germplasm can not only enhance the wanted resistance, but also broaden genetic diversity of sugarbeet for other traits.

Investigations of wild beets have a long history. In 1927 taxonomy of the genus Beta was documentally divided into three sections, i.e., Patellares, Vulgares and Corollinae. Since then various aspects of research on the origin, phylogenesis, morphology, cytogenetics, and reproductive biology of wild beet species have been actively pursued by many workers.

Germplasm in the species of sections Patellares and Corollinae has special attributes that may contribute to sugarbeet improvement. Through greenhouse and laboratory evaluations, source wild beet germplasms resistant to specific pathogens can be identified and parental genotypes selected for the improvement of particular desired sugarbeet traits. Thus, identification, accumulation and incorporation of wild beet genes from diverse sources into germplasm pools of sugarbeet becomes an important link in germplasm enhancement and crop improvement.

Seed from 53 accessions of section Patellares and section Corollinae wild beets collected from various sources were used in this study. Included were 26 accessions of B. patellaris, 13 of B. procumbens, 13 of B. webbiana, 14 selections from their progeny, and one accession of B. corolliflora. Seeds of wild beets generally do not germinate readily without scarification. Sulfuric acid was used to scarify the seed coat, followed by neutralization with a solution of baking soda, sodium bicarbonate. Some was accomplished by scratching the seed coat with sand paper. The treated seed was germinated in steam sterilized sand.

Germination of seeds from these wild beet accessions was generally poor. It ranged from 0 to 35%. Eleven strains of source seeds failed to germinate. This comparatively low germination rate of the wild beet collections suggested that a prolonged exposure of the seed to uncontrolled conditions may have caused significant losses in seed viability. In terms of the safe storage of seeds the most critical factor would be moisture content, especially for sealed storage. Undesirable storage environments, such as high humidity and high temperature, usually accelerate decline of viability of seed.

For testing of sugarbeet nematode (Heterodera schachtii Schm.) resistance, seedlings of the Patellares species were transplanted at the two-leaf stage to aluminum foil cylinders containing nematode-infested soil with 60 or more cysts per cylinder. Test plants were grown in a temperature controlled greenhouse at 21 to 27° C with a 16 hour photoperiod. Six to 7 weeks after transplanting, roots of each plant were examined for white female cysts. All plants, regardless of the level of cyst development exhibited, were replanted in nematode-infested soil for two additional screenings. In the later tests, 20 brown cysts were pipetted into the soil immediately around the plant to ensure high nematode populations. At about 7 weeks after the third inoculation, plants which still supported less than 10 nematode cysts were classified as resistant. Four plants with no cysts and 10 plants with cysts attached to roots were selected and reproduced in greenhouse or in field plots. Progenies of these plants were again tested to evaluate the heritability of the cyst supporting nature of the wild beets.

Results from these tests showed that the three Patellares species were highly resistant, but not immune, to the sugarbeet cyst nematode. The levels of cyst-free plants were 95.7%, 98.3%, and 93.1% for B. patellaris, B. procumbens, and B. webbiana, respectively (Table 1). Only small numbers of the young seedlings were found to have their root systems parasitized by a few cysts in the first test. The cysts were found on wild beets belonging to five B. patellaris, two B. procumbens, and three B. webbiana accessions. In the second test, a reduced number of cysts were detected in five of the 20 cyst-bearing plants from the first test. These five plants supported no cyst development in the third test. No cysts were observed on the remainder of the inoculated wild beet plants.

These demonstrated that resistance factors in the Patellares species resulted in high mortality of sugarbeet nematode juveniles feeding on the wild beets and their derivatives. Resistance in these genotypes had been determined not due to the failure of nematode larvae to enter roots of resistant host plants, but was due to failure of the large majority of larvae to achieve full development in the roots. The mechanism for nematode resistance of this Patellares origin has been attributed to antibiosis, which was triggered by the presence of a phytoalexin that formed after infection, according to a biochemical assay. This resistance is, therefore, a postinfectional resistance.

With the same test for resistance, there were no statistical differences in the high levels of resistance between groups of progeny derived from cyst-bearing and cyst-free wild beet parents (Table 2). In both types of progenies, rates of resistance to sugarbeet nematode equal to or higher than those exhibited by their parental populations were observed. They were 97.6% vs. 95.7% for the cyst-bearing B. patellaris plants, and 98.1% and 99.0% vs. 98.3% for cyst-bearing and cyst-free B. procumbens.

In this study nematode cysts have developed in all three Patellares species (Table 1 and 2). This is the first time that the development of adult females of sugarbeet nematode in B. webbiana species has been reported. Occasional development of adult females was previously reported only in B. patellaris and in B. procumbens. On the other hand, adult males of sugarbeet nematode have been previously detected in all three Patellares species. Nematode resistance in the Patellares species seems to have strengthened as

plants became mature. No cysts were detected at the end of the third test (Table 1) on any of the test plants. Seedlings were approximately five months old at this stage. Plants of section Patellares, therefore, may have the capability of establishing so-called adult plant resistance, or age resistance, when fully grown.

The casual development of nematode cysts in young wild beets may or may not be a characteristic transmittible to their offspring. In both cyst-bearing and cyst-free progeny families, only limited numbers of plants sustained cyst development (Table 2). The fact that cyst-bearing plants generated about equal or even higher numbers of cyst-free offspring as compared to their parental populations (Tables 1 and 2) indicated that occasional support of the cyst development was not an inheritable genetic factor. Presumably, the influence of a specific environment may favor the plant or the nematode unequally, which affects the expression of susceptibility. In this case, such an effect was observed through the occasional development of adult females on the juvenile wild beets.

Curly top of sugarbeet is one of the oldest known leafhopper-transmitted diseases. Seedlings of B. corolliflora and B. patellaris to be screened for resistance to beet curly top virus (BCTV) were transplanted to sterilized soil. These seedlings were inoculated by caging 8-12 viruliferous leafhoppers, Circulifer tenellus (Baker), in plastic cages or under sleeve cages for 5 or more days. Curly top symptoms did not appear on the wild beets. Four weeks after inoculation, 12-20 young nonviruliferous leafhoppers that were confined to small plastic cages were fed on the inoculated plants for 2 days to recover the virus. Leafhoppers were then transferred to four seedlings of the highly BCTV susceptible sugarbeet line 742 for 3 days feeding. Susceptibility of the individual wild beet plants was determined by the performance of these indicator plants. Leafhopper colonies were obtained from Dr. Duffus' laboratory.

The rate of negative reaction to BCTV virus inoculation in B. corolliflora and B. patellaris was approximately 90.0% in this test. Most of the infected B. corolliflora and some of the infected B. patellaris plants seemed to have a tendency to exhibit reduced vigor and became difficult to maintain in the greenhouse. After a period of time several infected plants eventually died. Four of the six available BCTV infected B. corolliflora plants showed significant virus concentration when tested by Dr. Liu with the enzyme-linked immunosorbent assay, ELISA. Virus concentration of the other two wild beets did not reach a significant level, based on densitometer reading. This suggests that although ELISA usually has a high sensitivity in detecting the existence of viral pathogens, it may be not universally applicable in cases such as BCTV infection in wild beet. It is considered that degrees of virus concentration and viral activity may shift in response to specific host-plant reactions and surrounding temperatures.

Rhizomania, a bearded root disease of sugarbeet, is incited by beet necrotic yellow vein virus (BNYVV), which again is vectored by a soil fungus, Polymyxa betae Keskin. Resistance to rhizomania infection in the wild beet was observed on the volunteer Patellares plants in the infested sugarbeet field plots, and on the wild beet seedlings grown in the infested soil in a

greenhouse. Rhizomania infested soil was collected from infested sugarbeet fields at Salinas and Spreckels, California.

The Patellares species probably were resistant to rhizomania, since no noticeable disease symptoms (proliferation of lateral rootlets) and negative reactions to ELISA tests have been detected in those wild beet plants under investigation. It is interesting to mention here that infestation of rhizomania pathogen(s) may have a striking negative effect to the stability of sugarbeet nematode population density. Serious sugarbeet rhizomania symptoms were distinguished in California for the first time in 1983. However, in a heavily nematode infested field at Salinas, where distinct viral yellowing symptoms with necrotic lesions were observed on leaves of several infected sugarbeets, numbers of viable nematode cysts were drastically reduced in that single season (Table 3) with no other obvious factors being evident. It is considered that the texture and contents of the stunted taproots and bearded rootlets of the infected sugarbeet plants may become undesirable for feeding by the nematodes.

The three Patellares species were also reported to have high resistance to the Erwinia sp. root rot bacterium (Whitney, 1982, Plant Dis. 66:616, as well as resistance to the clover cyst nematode, H. trifolii Goffart (Steele et al., 1983, J. Nematol. 15:281). However, these same wild beet species were readily classified as susceptible to the beet western yellows virus (BWYV), and highly susceptible to the leaf spot fungus, Cercospora beticola, based on our previous observations. The high susceptibility of Patellares species to the Cercospora leaf spot is in contrast to what have previously been reported in literature. Besides, the three Patellares species were reported (Golden, 1959, J. ASSBT 10:444; Di Vito, 1983, J. Nematol. 15:144) to have considerable susceptibility to sugarbeet root-knot nematodes, Meloidogyne spp.

Table 1. Development of sugarbeet nematode cysts (+) in Patellares species of the genus Beta.

Source species	No. plant	No. accession	Nematode development		
			1st test	2nd test	3rd test
B. patellaris	224	22	0	0	0
	8	4	+	0	0
	2	2	+	+	0
B. procumbens	296	13	0	0	0
	3	1	+	0	0
	2	2	+	+	0
B. webbiana	67	7	0	0	0
	4	3	+	0	0
	1	1	+	+	0

Table 2. Development of sugarbeet nematode cysts in progeny of the selected cyst-bearing (+ cysts) and cyst-free (0 cyst) Patellares plants.

Source species	Cyst type	Plant no.	No. progeny	Nematode development	
				0 cyst	+ cysts
B. patellaris	+ cysts	17A1	11	11	0
		17A2	22	21	1
		17A3	17	16	1
		17C1	21	21	0
		17C4	11	11	0
		17D1	11	10	1
		17E1	31	31	0
			124	121	3
B. procumbens	+ cysts	19A1	89	89	0
		19A3	152	148	4
		19A4	22	21	1
			263	258	5
B. procumbens	0 cyst	1902-1	26	26	0
		1909-1	28	28	0
		1913-1	23	22	1
		1915-1	24	24	0
			101	100	1

Table 3. Shift of Heterodera schachtii population density in nematode-infested sugarbeet fields where rhizomania symptoms suddenly appeared in the summer of 1983, in Salinas Valley of California. (Mean of viable cyst counts/200 ml soil from randomly collected soil samples, 4 to 10 replications.)

Field sites	1982		1983			1984
	May[a/]	Nov.[b/]	May[a/]	Oct.[c/]	Dec.[b/]	May[a/]
Salinas	101	158	--	17	29	19
Spreckels	--	--	49[d/]	25	21	--

[a/]; [b/]; and [c/] Soil collected from cultivated fields before planting (a); after harvesting (b); and soil surrounding sugarbeet roots, before harvesting (c).

[d/] Data obtained from Dr. J. D. Schulke, Amstar Corporation, Spreckels Sugar Division, Spreckels.

BREEDING FOR RESISTANCE TO SUGARBEET YELLOW WILT

J. S. McFarlane

Between 1963 and 1984, the United States and Chile conducted cooperative research to study the destructive yellow-wilt disease and to breed for resistance. Significant progress was made in the development of resistant breeding lines and the cooperative research was discontinued in 1984. The results of the breeding studies were summarized in an unpublished report entitled "Breeding for resistance to sugarbeet yellow wilt. Final report--July 1, 1984." This report has been distributed to members of the Beet Sugar Development Foundation.

A performance test with three of the most promising open-pollinated selections compared with an unselected line was conducted at Salinas, CA in 1984 and the results are presented in the accompanying table. The selections produced a similar root yield to the susceptible F81-37 pollinator line but were deficient in sucrose percentage, bolting resistance and percentage of clean beets.

The 83W301 line possesses the highest level of resistance and was developed by making seven successive selections for yellow-wilt resistance. The original selection was made from a hybrid between a curly top resistant variety and an unknown Chilean Beta source. The progeny of this hybrid showed improved resistance but lacked bolting resistance and possessed Swiss-chard characteristics. Many of the Swiss-chard characteristics were eliminated during the selection process but bolting susceptibility and sprangled roots are still evident in the seventh successive selection.

The 84W102 line contains resistant genes from South American lines similar to 83W301 and from wild beets that occur in Chile. Sugarbeet genes from the C17 pollinator line have also been incorporated. This line offers opportunity for additional yellow-wilt resistance selection.

The 84W101 line was selected from the backcross of (C17 x South American lines) to C37. This selection is similar to sugarbeet in root and plant characteristics but is deficient in sucrose percentage and is less resistant to yellow wilt than is 83W301. The line is worthy of additional selection and needs additional backcrossing to sugarbeet.

Seeds of these and other selections have been placed in the National Seed Storage Laboratory in Fort Collins, CO and the Regional Plant Introduction Station in Ames, IA. These seeds are available to breeders should the yellow-wilt disease be introduced to the United States.

PERFORMANCE OF YELLOW-WILT RESISTANT SELECTIONS, SALINAS, CA, 1984

4 varieties x 5 replications
2-row plots, 30 ft. long

Planted: March 9, 1984
Harvested: October 10, 1984

Entry[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Clean Beets	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
	Lbs.	Tons	%	%	%	Number	%	%	%	Lbs./T
84W101	7,475	23.15	16.15	4.4	0.0	133	82.5	3.37	82.7	267
F81-37	7,013	19.85	17.67	0.0	0.3	128	89.9	3.53	83.3	294
84W102	6,491	20.61	15.73	15.9	0.3	127	65.9	3.50	81.8	257
83W301	5,658	19.58	14.47	18.7	0.0	118	47.2	3.82	79.1	228
Mean	6,659	20.80	16.01	9.8	0.1	127	71.4	3.56	81.7	262
LSD(.05)	1,081	NS	0.89	5.1	NS	8	5.3	0.24	1.5	18
C.V.(%)	11.8	11.50	4.00	37.7	329.2	4.6	5.4	4.8	1.3	5.1
F value	4.9*	2.3NS	20.9**	29.7**	0.6NS	5.3*	121.1**	6.1*	14.5**	20.3*

[1/] Description of entries.

84W101 = F_3[C37 x (C17 x South American lines)]

F81-37 = Pollinator for hybrid variety US H11

84W102 = F_4[(C17 x Chilean wilds) x South American lines]

83W301 = Pool of South American lines developed through seven successive selections for yellow-wilt resistance.

SUMMARY OF TRIALS, 1984

VIRUS YELLOWS, ERWINIA ROOT ROT, AND POWDERY MILDEW RESISTANCE BREEDING--Germplasm improvement for multiple disease resistance was continued. Individual plant selections under severe disease conditions (VY, ERR, and PM) were made on the basis of freedom from disease symptoms, gross sugar yield, and root conformation. Emphasis was continued on the % sucrose component of yield. Breeding lines in this program were evaluated for reaction to VY (BWYV) in tests 2484, 2684, and 2784 and to ERR and PM in test 2984. In contrast to the obsolete O.P., MM variety US 75 (968), under VY conditions several of the multigerm lines have sucrose content 2 to 3 percentage points higher and also are significantly improved for root yield.

Two advanced germplasm lines from this program are proposed for release in 1985. These are reselections from lines Y341 and Y352 (Test 2784). The line to be released from Y41 is cycle 6 of individual plant selection for combined resistance to VY, PM, and ERR. It appears to be highly resistant to Erwinia and have the best resistance to powdery mildew available in adapted germplasm (Test 2984). Y41 remained the greenest of all lines over the full season in VY test 2784. Y41 was derived from a cross between C01 and C64 and has only fair resistance to curly top and bolting. To improve the curly top and bolting resistance of the Y41 germplasm, Y41(C2) was crossed to C37 to produce breeding line Y52. Subsequently, Y52 has undergone two additional cycles of selection for combined resistance to VY, ERR, and PM. Y41 and Y52 germplasm lines are being evaluated for hybrid performance in 1985 tests at Salinas and Brawley. R. T. Lewellen, I. O. Skoyen, and E. D. Whitney.

GCA OF S_3 LINES DERIVED BY SSD--In 1983, 60 3-way hybrids in which the O-type components were derived by single-seed descent (SSD) from popn-790 were tested. Procedures to produce the S_3 lines and 3-way hybrids and the summary of Test 1083 were given in the 1983 Report, pages A14-16. Rather than retesting all 60 hybrids in 1984, only a portion of the hybrids were retested to verify the 1983 results. Based upon Test 1083, 27 3-way hybrids and 5 checks were evaluated in Test 2084 and 12 3-way hybrids and 4 checks were evaluated in Test 2884. The hybrids selected for reevaluation were those with the highest and lowest performance for sugar yield and % sucrose. It was assumed that these sets of entries would represent the extremes in GCA within popn-790 and would provide information on the usefulness of SSD for extracting and fixing genotypes. The 1984 data are summarized in Tests 2084 and 2884.

The 1984 data corroborates that from 1983. Even though the S_3 lines derived from popn-790 by SSD represented only 25% of the parentage in the 3-way hybrids, there were significant differences in performance of these experimental hybrids. On the basis of these tests, it would appear that inbred lines (pure lines) with superior GCA can be easily and efficiently extracted from an improved sugarbeet population by SSD.

The 3-way hybrids had a common CMS inbred line (C779) and topcross pollinator (C46). In all tests the single cross C779CMS x C46 and the population hybrid popn-790CMS x C46 were included as checks. Thus it was possible to predict the approximate performance of the potential single

cross hybrids between individual 790-S_3 lines and C46. For example, Table 1 contrasts the performance of S_3 lines 790-69 and 790-21.

TABLE 1. PREDICTED PERFORMANCE FOR A HIGH VS. LOW YIELDING SINGLE CROSS INVOLVING 790-S_3 LINES

Description			Relative to SX check		
CMS	T-O	♂	SY	RY	% S
SX check*					
C779		C46	100	100	100
Actual 3W hybrids*					
C779	790-69	C46	109a	105a	104
C779	790-21	C46	94b	93b	102
Predicted SX**					
	790-69	C46	118	110	108
	790-21	C46	88	86	104

*Mean of 3 tests, 1983-84.
**Jenkins' method B and Skaracis & Smith.

Likewise, the predicted hybrid performance of these S_3 lines can be compared to that of their source population (Table 2).

TABLE 2. PREDICTED PERFORMANCE FOR A HIGH VS. LOW YIELDING SINGLE CROSS INVOLVING 790-S_3 LINES RELATIVE TO THE PERFORMANCE OF THE POPN-790 HYBRID

Description		Relative to popn hybrid		
♀	♂	SY	RY	% S
Actual popn hybrid				
Popn-790	C46	100	100	100
Predicted SX				
790-69	C46	115	109	107
790-21	C46	85	84	103

Based upon mean of 3 tests, 1983-84.

These predicted performances for S_3 lines 790-69 and 790-21 suggest that in actual sugar yield values, the genetic variability for GCA ranged at least ± 15% from that of the source population 790. Thus, based upon a relatively few extracted S_3 lines and the conditions of these tests, an inbred line was

extracted from 790 that had a 15% improvement in hybrid performance compared to the mean performance of the population hybrid.

Much of the breeding effort at Salinas involves population improvement within self-fertile, monogerm populations. Following the development of these populations and achieving relatively desirable levels of disease resistance and hybrid performance, SSD may be a desirable method to extract superior near-homozygous lines for use as parental lines in hybrids. The results of this program also may provide some insight into what can be expected from homozygous lines derived from doubled haploids. The exception may be that most haploids will be derived from self-sterile sources that carry high genetic loads of lethal and deleterious recessives. For either SSD or doubled haploid breeding methods, the use of self-fertile populations may be highly desirable. The F_1 CMS hybrid C546H3 (C562CMS x C546) has been a widely used seed bearing parent for commercial hybrids in California and C546H3 x C46 was included as a check in these tests. In all trials, the S_3-790-69 line was superior to C546H3 in CA with C46. Line 790-69 and several others may be released in 1985 so that they can be extensively tested. R. T. Lewellen and I. O. Skoyen.

S_1 PROGENY RECURRENT SELECTION--Tests in 1983 (1983 Report, pages A13 and elsewhere) showed that S_1 progeny recurrent selection (RS) was effective at improving population performance for sugar yield through two cycles of selection. It was also shown that S_1 progeny RS increased the hybrid performance of the improved synthetics. However, the improvement was much greater in a late (April) planted trial than in an early (January) planted trial. In 1984, the C0, C1, and C2 synthetics and hybrids with these synthetics were reevaluated in January and April planted trials. The results were nearly identical to those obtained in 1983. (See Tests 784-1 and 784-2.) The results from 1983 and 1984 are summarized in the following tables.

TABLE 1. RESPONSE OF SYNTHETICS PER SE TO 2 CYCLES OF S_1 PROGENY R.S. FOR SUGAR YIELD IN POPULATION 790

		% Gain		
Cycle	Description	SY	RY	% S
C0	per se	0.0	0.0	0.0
C1	" "	10.2	11.3	-1.4
C2	" "	18.7	15.7	2.5
C2(S_1+BP)	" "	17.0	12.8	3.6

Mean of 4 tests in 1983-84.

Table 1 summarizes the response to selection for the synthetics per se. Most of the improvement for sugar yield resulted from changes in the root yield component. The exception appeared to be the synthetic C2 (S_1 + BP) that combined 1 cycle of S_1 progeny selection followed by 1 cycle of bulk

population (BP) selection. For the BP selection, S_1 seed from individual S_o plants was bulked and selection was based upon individual plant performance rather than progeny performance. Whereas S_1 progeny selection seemed to capitalize mostly on root yield variability, BP selection appeared to capitalize on differences in sucrose concentration. Theoretically, S_1 progeny RS is a powerful technique to select for additive effects (e.g. %S) and not dominance effects (e.g. root yield), so these results are somewhat surprising. The first cycle of S_1 selection was based almost strictly on gross sugar yield and resulted in a decrease in % sucrose. Because of this trend, the 2nd cycle of S_1 selection also was based on gross sugar yield but weighted toward lines w/ high % sugar (a minimal value was placed on the % sugar that was acceptable). This criterion appeared to put the components of yield into balance with simultaneous increase in both %S and root yield. With S_1 progeny recurrent selection, relatively few S_o genotypes can be efficiently evaluated (e.g., 100-144). Whereas with BP selection, many hundreds of S_o plants can be selfed and evaluated. Even though the S_1 seed for C2 and C2^o(S_1 + BP) involved the same source and number of plants, BP selection was nearly as effective. Because many more S_o genotypes could be evaluated and done so with much less expense and breeding resources, BP selection may be a desirable breeding technique to improve population performance. It is also much more adaptable to selecting for multiple disease resistance.

TABLE 2. RESPONSE OF TOPCROSS HYBRIDS TO 2 CYCLES OF S_1 PROGENY R.S. FOR SUGAR YIELD IN POPULATION 790

		% Gain		
Cycle	Description	SY	RY	% S
C0	C0aa x C46	0.0	0.0	0.0
C1	C1aa x C46	5.7	7.1	-1.5
C2	C2aa x C46	8.9	8.3	0.0
C2(S_1+BP)	C2aa x C46	8.3	6.5	1.1

Mean of 4 tests in 1983-84.

Table 2 summarizes the response to S_1 progeny RS in topcross hybrids. As with the synthetics per se, most of the improvement was for root yield. In all cycles and comparisons the gain for the hybrid was essentially one half of that shown by the synthetics per se. After two cycles of selection, the topcross hybrid was improved by about 9% in sugar yield. The four tests in 1983 and 1984 were grown in split-plots in which main plots were synthetics vs. topcross hybrids and subplots were cycles of selection. As Table 3 shows, except for one test for sugar yield, significant interaction did not occur between synthetics and their hybrids. This lack of interaction suggests that in these tests, the hybrids were performing proportional to the performance of the synthetics per se. Also, this lack of interactions suggests that the performance response of the synthetics per se would accurately predict the performance of their topcross hybrids (i.e., the

hybrids gain or response to selection is equal to one-half of that for the population).

TABLE 3. LEVEL OF SIGNIFICANCE FOR MEAN SQUARES FOR PERFORMANCE OF SYNTHETICS PER SE X THEIR TOPCROSS HYBRIDS

Test	Sugar Yield	Root Yield	Sucrose %
13 Jan., 1983	NS	NS	NS
17 Jan., 1984	NS	NS	NS
7 April, 1983	NS	NS	NS
12 April, 1984	*	NS	NS

Split-plot designs, 4 cycles x 2 trtmts. (per se vs. hybrids), 8 replications.
*Interaction significant at 5% level.

One of the interesting findings of this study was the differences in the apparent response to selection when the synthetics and hybrids were evaluated under long and short season conditions.

TABLE 4. EFFECTS OF PLANTING DATE ON TEST PERFORMANCE FOR SUGAR YIELD AND ON RESPONSE TO 2 CYCLES OF S_1 PROGENY R.S.

Planting date	Test mean SY(lbs/a)	% Gain from C0 to C2 per se	% Gain from C0 to C2 hybrid
13 Jan., 1983	12,900	8.4 NS	2.7 NS
17 Jan., 1984	10,500	12.3**	4.6 NS
7 April, 1983	7,800	26.1**	19.6**
12 April, 1984	7,700	28.1**	8.5*

*, ** Significance at 5 and 1%.

As shown by Table 4, trials planted in January suggested that two cycles of selection had resulted in only a small gain (8-12% for the C2 synthetic per se and 3-5% for the hybrid w/ the C2 synthetic). This contrasted greatly with the measured response to selection in the April planted trials where gains of 26-28% and 9 to 20% occurred for the synthetics and hybrids, respectively. The basis for these differences in response is not known. However, the S_1 progeny tests were conducted under short season conditions and possibly specifically identified genotypes that performed well in this situation. This difference in response under long vs. short seasons might also suggest that greater discrimination among genotypes, lines, hybrids,

etc. may occur under short season conditions and that short seasons at Salinas are better for separating differences in performance than long seasons. This has been suggested by many of our trials over the years. We have normally had relatively greater dispersion of means w/in a test under late plantings (March-May) than we have had under early (December-February) plantings. R. T. Lewellen and I. O. Skoyen.

S_1-TESTCROSS PROGENY EVALUATION--Starting in 1979, S_1 progeny families were extracted from population 8755. In 1980, the male-sterile plants in these S_1 lines were topcrossed to C37. These S_1-TX progenies were evaluated in 1981. Based upon the results of the 1981 progeny test, a 20% selection intensity was practical for S_1 families that appeared to have combining ability for high sugar yield, low sugar yield, high % sucrose, and low % sucrose. C0 and C1 synthetics were produced in 1982 from selected S_1 families. In 1983 and 1984, the C0 and C1 synthetics and topcross hybrids with these synthetics were evaluated at Salinas and Brawley. Some of the results from these trials are shown in Tests 984-1, 1084-1, and B284. The near lack of response to selections shown by the C1 synthetics per se and their hybrids was disappointing. It is believed that the lack of success for improving the 755 population based upon this early generation testing procedure resulted from poor progeny test performance rather than lack of genetic variability. As is widely known, the most critical aspect of population improvement by progeny testing is the ability of the progeny test to adequately discriminate differences among the set of progenies. In this case, it appears that selection was made more or less randomly. However, based upon subsequent retests of individual S_1-TX lines, it was apparent that differences did exist within these progenies. Lines C301 through C308 were released from this material.

A new set of S_1 lines was produced from reselected population 755 in 1980 and S_1-TX progenies were evaluated at Salinas and Brawley (under severe lettuce infectious yellows conditions) in 1982. Based upon these S_1-TX progeny tests, divergent selections at 20% intensity were made for high sugar yield and high and low sugar yield under LIY conditions. The C0 and C1 synthetics and their hybrids were tested at Salinas and Brawley in 1984 (see Tests 884-1, 884-2, 1784, 1884, and B184). As shown by Tests 884-1, 884-2, and B184, the S_1-TX evaluation and selection procedure successfully caused the sugar yield performance of the C0 vs. C1 synthetics to diverge. This suggested that this early generation evaluation method had merit for improving the hybrid performance of a sugarbeet population.

As with the previous S_1-TX evaluations, this second set of progenies suggested that specific S_1 lines had value and were retested. One of these S_1 lines was identified as 0755-46 and was later increased as line 3755-46 and 816. This monogerm, O-type line appears to have homozygous resistance to Erwinia (Test 2984) and contributes high sucrose content to hybrids (Tests 1684 and 1784). Plans are to make this line available in 1985 for widescale testing. It will be identified as C309. R. T. Lewellen and I. O. Skoyen.

S_2-TX PROGENY EVALUATION--S_1 and S_1-TX recurrent selection have been used at Salinas for several years to evaluate and select for improved combining ability. Both of these methods rely upon the efficacy of early testing to discriminate differences in S_0 genotypes. Evidence from maize breeding

studies suggests that yield evaluation at the S_2 level may have advantages: 1) Strong selection pressure can be applied to S_1 families and plants for highly heritable traits and agronomic type before producing S_2 topcrosses; 2) The additive component of variance is larger than that for among S_1 progenies; and 3) S_2 lines selected should have direct potential for developing new parental lines. Obviously, a disadvantage is that one additional year per cycle of selection is required.

A small number of S_2 lines from two narrow populations were used to evaluate this procedure in sugarbeet. Populations 214 (1214, 2214, 3214, 764, and H63) and 216 (1216, 2216, 3216, 2217, 3217, 767, and H64) were used. Popn-214 was derived from a cross between popn-755aa x C758. Popn-216 was derived from a cross between popn-755aa x C546. S_o plants were extracted from both popns and selfed. Randomly selected S_1 plants were selfed to produce the S_2 lines. Because the S_o plants were Aa, by chance, 2/3 of the S_2 lines segregated 3A:1aa. For these S_2 lines, topcrosses were made onto the genetic male-sterile segregates (aa). In 1984, 21 S_2-TX's of 216 and 15 S_2-TX's of 214 were evaluated at Salinas in Test 684. The results of Test 684 are given below.

Test 684. Performance of S_2-TX progenies

40 entries x 4 reps., RCB — Planted: January 17, 1984
1-row plots, 30 ft. long — Harvested: September 12, 1984

Entries		Acre Yield			Root
MS	σ	Sugar	Beets	Sucrose	Rot
		lbs	tons	%	%
Check[1/]					
C546H3	C46	11,070	29.9	18.5	0.3
S_2-TX's of 216[2/]					
216-S_2aa	C46	9,690-12,250	26.7-34.3	17.5-19.1	0.0-1.6
S_2-TX's of 214[3/]					
214-S_2aa	C46	8,910-11,540	23.5-30.9	17.7-19.9	0.0-6.5
Individual S_2-TX's					
216-14aa	C46	12,250	34.3	17.9	0.0
216-23aa	C46	11,990	31.6	19.1	0.0
216-8aa	C46	11,500	30.2	19.1	0.0
214-33aa	C46	11,540	30.1	19.2	0.0
214-30aa	C46	11,090	29.8	18.6	0.0
214-37aa	C46	9,470	23.9	19.9	0.0
Mean		10,720	29.0	18.5	0.5
LSD (0.05)		1,380	3.8	1.0	NS
C.V. (%)		9.2	9.3	3.7	438
F value		2.5**	3.0**	1.9**	1.3NS

1/ Mean of 4 entries.
2/ Range of 21 entries.
3/ Range of 15 entries.

Until the hybrid performance of individual S_2 lines and increases of these lines can be reevaluated and the derived C1 synthetics compared to the CO source, the potential usefulness of S_2 progeny performance in a sugarbeet breeding program will not be known. Test 684 tentatively suggests that S_2-TX performance could be used to differentiate and select S_o plants with desirable GCA. R. T. Lewellen and I. O. Skoyen.

PROGENY EVALUATION OF POPN-796--In 1984, sugarbeet population C796 was released. C796 is a monogerm, near-T-O, self-fertile (S^f) population that segregates for genetic male sterility (A:aa). It was developed by intrapopulation improvement methods for combined disease resistance and productivity. Starting in 1969, the best available sources of resistance to curly top and virus yellows were combined in a series of composite crosses. Sources included C13 and C17 (34%), reselections from Reitberg's YR line C234 (13%), NB1 (3%), and 12 monogerm, T-O, CT resistant, nonbolting inbred lines (50%), e.g., C563, C536, etc. Two cycles of individual plant selections based upon root yield, % sucrose, root conformation and freedom from disease were made from spaced plants that had been inoculated with VY, Erwinia, and PM. A final cycle of selection was based upon S_1 progeny performance for resistance to curly top and for T-O in greenhouse tests. Thirty S_1 families were recombined and increased to produce C796. C796 combines favorable resistance to CT, VY, NB, and ERR and in population hybrids has been similar to C546H3 for performance. Within monogerm sources, C796 may have the highest level of resistance available to virus yellows.

In 1982, S_o (Aa) plants were randomly extracted from popn-796 and selfed to produce S_1 progeny families. In 1983, these families were rogued to aa plants and topcrossed to C46. These S_1-TX progenies were evaluated at Salinas in 1984. A screening test with 56 S_1-TX entries and 8 checks with 4 replications was used. The results of this test are summarized in Table 1.

TABLE 1. Test 2184: Means and ranges for S_1 progeny families from C796 topcrossed to C46.

64 entries x 4 reps., RCB
1-row plots, 30 ft. long

Planted: March 9, 1984
Harvested: October 9, 1984

Variable	Mean	Range	LSD (.05)	CV (%)
Sugar yield/A	11,100	9,000-12,800	1,410	9.1
Root yield/A	31.92	25.98-35.92	4.17	9.4
% sucrose	17.43	16.14-18.23	0.84	3.5
Root rot	0.3	0.0-2.4	NS	453
Beets/100 ft	100	61-124	20	14.1

Of the 56 S_1-TX entries, 13 were selected for retest in 1985. The S_1 progenies of these 13 families are being increased and if warranted by their retest performance, a few may be released. For future reference, the performance of these specific S_1-TX's in the 1984 test are listed in Table 2 in comparison to the mean of the checks.

TABLE 2. Test 2184: Comparison of specific S_1-TX progenies of C796-S_1aa x C46 to checks.

Entry ♀	Entry ♂	Acre Yield[2/] Sugar	Acre Yield[2/] Beets	% Sucrose	% Root Rot
Checks[1/]					
546H3	C46	11,500	32.62	17.64	0.7
Popn-796aa	C46	11,200	32.21	17.43	0.2
S_1-TX progenies					
796-85aa	C46	12,800 (1)	35.24	18.23 (1)	0.0
-43aa	C46	12,700 (2)	35.92	17.75(14)	0.0
-114aa	C46	12,400 (3)	35.25	17.60(22)	0.0
-64aa	C46	12,000 (6)	34.43	17.43(30)	0.0
-15aa	C46	12,000 (7)	34.01	17.68(18)	0.0
-123aa	C46	11,700(12)	32.65	17.98 (4)	0.0
-42aa	C46	11,600(13)	32.37	17.93 (5)	0.0
-6aa	C46	11,500(15)	32.20	17.82(10)	0.9
-28aa	C46	11,400(16)	31.98	17.89 (7)	0.0
-93aa	C46	11,400(17)	31.82	17.88 (8)	0.0
-117aa	C46	11,300(19)	31.12	18.21 (2)	0.0
-132aa	C46	11,300(21)	31.15	18.15 (3)	0.0
-22aa	C46	11,300(20)	31.92	17.76(13)	0.0

[1/] Each check is mean of four entries.
[2/] Number in parenthesis is rank out of 56.

It is apparent from the results in Tables 1 and 2 that considerable genetic variability exists within C796 for GCA for sugar yield. One of the deficiencies of C796 is low sucrose concentration. However, it appears that lines with a sufficiently high sucrose level could be extracted.

Topcross tester C46 has considerable parentage (C17, C13) in common with C796 and may not have been the ideal tester. The hybrid performance of these S_1 families may be better when combined with nonrelated pollinators. Based upon S_1 family per se performance for curly top resistance, S_1 line 796-22 was also released in 1984 as C796-22. R. T. Lewellen and I. O. Skoyen.

ROOT TOUGHNESS--Two tests were conducted in 1984 on first and second cycle divergent selections for low fiber (soft) and high fiber (tough) sugarbeet roots vs. the effect of environment on root fiber. Hybrids with the parent lines and the first cycle lines were also included in the tests.

The 1984 test results were similar to earlier tests reported in Sugarbeet Research 1980 and 1982 Reports. Tables 1 and 2 summarize results for tests 584-1 and 584-2 for root toughness and yield. Generally, 1984 results are similar to earlier tests and show that root fiber may vary but the tendencies are in the same direction, i.e. the low fiber selection(s) is usually softer (has a lower lbf. probe value) than the parent and the high fiber selections (T) are significantly tougher than the parent. Second cycle selection for low (S-2) and high (T-2) fiber showed additional increments of divergent selection progress. Probe values of hybrids with

first cycle lines were intermediate between parent and tough (T) selection but were less definite for soft (S) selections. Environmental difference based on plant age (test seeding dates) were less distinct in 1984 than in earlier tests; however, the tendency was for younger roots to be less fibrous.

The combined mean 12- to 20-lbf classes from the frequency distribution (Table 1), expressed in percent, for parents, soft (S and S-2) and tough (T and T-2) selections were:

	1983-84	
	Test 584-1	Test 584-2
	%	%
Parent lines (P)	50.5	64.8
Low fiber sel. (S)	60.0	72.0
Low fiber, 2nd sel. (S-2)	69.7	81.5
High fiber sel. (T)	24.8	37.0
High fiber, 2nd sel. (T-2)	23.3 1/	15.8 1/

1/ Mean of two T-2 selections only, 336T-2 was not included in 1984 tests because of shortage of seed.

It appears from the above table that the second cycle selection resulted in about the same increment of change for low fiber as in the original selection. The high fiber second cycle means, based on two lines, were inconclusive.

Seed of the second cycle selections and their test cross hybrids were produced in 1984 and will be tested in 1985. I. O. Skoyen and R. T. Lewellen.

PRELIMINARY INVESTIGATION INTO THE INHERITANCE OF BOLTING RESISTANCE, 1984--
An important attribute of sugarbeet varieties grown in California is a high degree of bolting resistance. This is because sugarbeet culture includes crop overwintering and winter seeding practices. The purposes of this preliminary investigation, and an earlier one in 1974-75 (Sugarbeet Research 1975, A81-A83), were to obtain information on the expression of nonbolting tendency under different environments. The role of cultural treatments and particularly environmental conditions would be important to the investigation of inheritance of nonbolting tendency.

The commercial pollinators C37 (a selection from 417-1, the P_1 for the 1974-75 tests) and SP6822-0 were used as the bolting resistant and bolting susceptible parents, respectively. Both of these lines are open pollinated, however, they are fairly closely bred and should be nearly homozygous for bolting tendency traits. Since seed production environment may influence the subsequent bolting characteristics of a line, the parents and their progeny were increased in as nearly uniform conditions as possible in either seed isolation chambers or as bagged plant-pairs in the greenhouse. The parental lines and their progeny were seeded at Salinas and Medford, Oregon.

The results of three tests are summarized in the tables. As in 1974-75, incomplete bolting was a factor in Salinas Test 1, particularly in bolting resistant lines, and the data do not readily lend themselves to genetic analysis. However, with the essentially complete induction of the stecklings used in the transplanted plots (Tests 2 and 3), bolting counts were nearly normally distributed for all populations. There were distinct differences in the mean date of bolting between the parents in all tests. Although the rate of bolting was much more compact in the steckling plots the relationship between parents and segregating generations was reasonably consistent for both locations and counting dates.

In all three tests, as in 1974-1975 tests, the segregating populations were regressed toward the more bolting susceptible parent, suggesting that bolting resistance is inherited as a recessive trait.

Although bolting rates differed depending on amount of induction, it appears that the bolting tendency of these lines at one location should be predictive of their behavior at any other location.

Further study is needed to determine the inheritance of bolting and particularly the interaction of various environmental conditions and bolting tendency. I. O. Skoyen and R. T. Lewellen.

Test 1: Bolting at Salinas, 1983-84

No.	Generation	% Bolting 5/17 0[1/]	5/25 8	5/31 14	6/8 22	7/6 50	7/30 74	9/4 110	% Non-Bolters	No. N
3201	P_1(C37)	0	0	0	0	0	0	0	100	103
3205	BCP_1	0	0	0	0	1.6	4.7	7.0	93.0	129
3204	F_1	0	0	0	0	4.1	11.1	16.7	83.3	270
3203	F_3	0	0	0.2	1.9	11.4	20.0	26.4	73.6	421
3206	BCP_2	0	1.4	1.4	4.8	12.9	21.8	25.9	74.1	147
3202	P_2(SP6822-0)	4.5	9.7	13.4	19.4	41.8	51.5	61.2	38.8	134

[1/] Days elapsed after first count.

Seeded December 21, 1983. Plots were single row 27 ft. long. A randomized block design was used with four replications and entries included from 1 to 3 times per replication. Bolted beets were not removed, but seed stalks were occasionally cut back. Cultural practices were equivalent to those of other Salinas sugarbeet trials.

Test 2: Bolting in a steckling transplant plot at Salinas, 1984

No.	Generation	% Bolting 4/20 0[1/]	4/25 5	5/1 11	5/7 17	5/11 21	5/15 25	5/19 29	% Non-Bolters	No. N
F81-37	Inc. C37	0.6	9.7	36.5	88.2	96.1	97.4	97.4	2.6	153
3201	P_1(C37)	0	2.8	33.6	82.5	90.9	92.3	92.3	7.7	143
3205	BCP_1	1.0	18.8	54.7	90.3	96.3	98.0	98.0	2.0	298
Y238	F_2	2.6	9.9	43.4	92.7	95.3	97.3	98.0	2.0	152
3204	F_1	6.5	19.4	58.1	98.7	98.7	99.3	99.3	0.7	155
3203	F_3	4.2	18.3	52.5	94.1	97.3	98.6	98.8	1.2	450
3206	BCP_2	3.7	16.4	54.4	93.0	98.0	99.8	100.0	0.0	324
3202	P_2(SP6822-0)	3.4	24.4	61.5	96.6	100.0	100.0	100.0	0.0	148

[1/] Days elapsed after first bolting count.

Steckling roots were dug from Medford, Oregon about March 10, 1984 and held in a coldroom until transplanted on April 2, 1984. A randomized block design with three replications was used and entries included from 1 to 3 times per replication. Plants were counted as bolted when seed stalks reached 6 in. in length.

Test 3: Bolting in a steckling transplant plot at Medford, Oregon, 1984

No.	Generation	% Bolting 4/19 0	4/23 5	4/28 10	5/3 15	5/8 20	5/13 25	5/18 30	5/21 33	No. N
3201	P_1(C37)	0	0	0	10.0	67.6	95.4	99.4	100	151
3205	BCP_1	0	1.6	11.5	40.0	75.4	95.6	97.3	100	312
Y238	F_2	0	0	8.9	23.6	56.0	84.0	92.8	100	68
3204	F_1	0	1.3	11.9	52.3	88.7	97.9	98.6	100	151
3203	F_3	0	0.7	6.1	41.3	78.3	96.7	99.8	100	446
3206	BCP_2	0.3	0.6	12.8	52.9	91.0	97.4	100.0	100	302
3202	P_2(SP6822-0)	5.3	13.9	35.6	79.6	91.4	97.3	98.7	100	152

1/ Days elapsed after first bolting count.

Steckling roots dug from Medford area nurseries and transplanted into a plot at Medford about March 15, 1984. A randomized block design with three replications and entries included from one to three times per replication. Plants were counted as bolted and discarded when seed stalks reached 6 in. in length. Bolting counts were made at 2- to 3-day intervals between April 19 and May 21, 1984.

The Medford test was conducted in cooperation with Lee Rickords of West Coast Beet Seed Company.

FIELD VARIETY TRIALS, SALINAS, CALIFORNIA, 1983-84

Location: USDA-ARS Agricultural Research Station

Soil Type: Sandy loam (Chualar series)

Previous crops: 1983-84 Sugarbeet test areas, Spence Field:
Block 5 - 15A, Block 6 - 6A; fallow 1981-83, sugarbeets 1980.

Fertilizer used: Preplant: Block 5, 467 lbs/A 5:20:10 broadcast and chiselled in, Block 6, 440 lbs/A 12:12:12 broadcast and chiselled in prior to listing. Before seeding, about 330 lbs/A ammonium sulfate was Bye-Hoe incorporated in a 9-inch band into the beds.

Supplement nitrogen: One to three applications, as sidedress ammonium sulfate or by sprinkler system as 32% nitrogen in a liquid formation.

Total fertilization (lbs/A);	N[1/]	P_2O_5	K_2O
Block 5	250	93	47
Block 6	180	53	53

1/ Depending on seeding date.

Summary: 1983-84 Test at Salinas (Spence Field):

Test No.	Sowing Date 1983-1984	Thinning Date 1984	Test Entries No.	Reps No.	Plot Row No.	Plot Lgth. Ft.	Harvest Date 1984	Test Design
184	12/21	2/13	6	4	2	27	--	--1/
284	12/21	2/13	128	2	1	27	--	--1/
384	12/21	2/15	144	2	1	27	--	--1/
484	12/22	2/15	32	8	1	30	--	RCB1/
584-1	12/22	2/17	32	4	1	30	10/27	RCB
684	1/17	3/1	40	4	1	30	9/12-13	RCB2/
784-1	1/17	3/1	8	8	2	30	9/13-14	SP3/
884-1	1/17	3/1	8	8	2	30	9/11-12	SP
984-1	1/17	3/1	16	8	2	30	9/10-11	SP
1084-1	1/18	3/2	4	8	2	30	9/19	RCB
1184-1	1/18	3/2	12	8	2	30	9/18-19	RCB4/
1284	1/18	3/2	16	8	2	30	9/17-18	RCB
1384	1/18	3/3	16	8	2	30	9/19-20	RCB
1484	1/19	3/3	32	8	1	30	9/24-25	RCB
1584	1/19	3/3	16	8	1	30	9/21	RCB
1684	3/8	4/9	8	8	1	30	10/4	RCB
1184-2	3/8	4/9	12	8	2	30	9/27-28	RCB4/
1784	3/8	4/9	32	8	1	30	9/25-26	RCB
1884	3/8	4/10	32	8	1	30	10/1-2	RCB
2084	3/8	4/10	32	8	1	30	10/2-3	RCB
2184	3/9	4/10	64	4	1	30	10/9-10	RCB2/
2284-1	3/9	4/11	4	5	2	30	10/10	RCB5/
2284-2	3/9	4/11	253	1	1	13	--	--5/

Test No.	Sowing Date 1983-1984	Thinning Date 1984	Test Entries No.	Reps No.	Plot Row No.	Plot Lgth. Ft.	Harvest Date 1984	Test Design
2384	3/9	4/11	14	4	2	129	10/19,25-26	RCB
2484	4/11	5/14	10	8	1	30	10/24-25	RCB
2584	4/11	5/14	21	8	1	30	10/15-16	RCB
2684	4/12	5/15	16	8	1	30	10/22-23	RCB
2784	4/12	5/15	16	8	1	30	10/23-24	RCB
584-2	4/12	5/16	32	4	1	30	10/30-31	RCB
784-2	4/12	5/16	8	8	1	30	10/29	SP
884-2	4/12	5/17	8	8	1	30	10/29	SP
2884	4/12	5/17	16	8	1	30	10/30	RCB
2984	5/23	6/27	192	2	1	20	--	--[6]
3084	5/25	6/28	36	4	1	20	10/22	RCB[7]
3184	5/25	6/29	24	8	1	20	10/30	RCB[8]

1/ Tests 184-484, bolting obs. tests - not harvested (bolting did not occur).
2/ Incomplete blocks.
3/ Split plot.
4/ Coded variety trials (Area 4).
5/ Yellow wilt resistance yield plot and observation plot.
6/ PM-ERR Obs. tests - Spence Field.
7/ Variety evaluation for PM-ERR.
8/ Evaluation of Chinese Accessions.

Irrigation: By either furrow or sprinkler system as required at 7-14 day intervals except during stand establishment when frequent light sprinkler irrigations were used.

Herbicide use: Nortron at an average rate of 0.56 gal/A and Pyramin W, at an average rate of 3.35 lbs/A, were sprayed post plant and watered in with 1/2 to 3/4 inch sprinkler irrigation.

Disease and insects: Natural virus yellows infection was moderate in January and March seeded tests and moderately sever in April and May seedings. Insect infestations were minor throughout growing season.

Powdery mildew was severe in 1984 where it was not controlled and appeared first (late June) in the earliest seeded tests. Excellent control was obtained with a single application of Bayleton. Spray applications of Bayleton, depending on appearance of P. M. in later seedings, at a rate of 8-10 oz ai/A were made on July 2 and 26, 1984.

Downy mildew infection was nil in 1984.

Natural infection of Erwinia soft rot was light in susceptible lines in 1984. Impact on yield was slight. Counts of rotted roots were made at harvest.

Sugarbeet nematode was observed in spots in 1984 test areas but had a slight effect on yield.

Rhizomania and/or unidentified severe seedling blights were not observed in 1984 test areas.

Sugar analysis: Determined from two samples per plot of approximately 10 roots each or 25-40 lbs. of roots at the sugar analytical laboratory, U.S. Agricultural Research Station, Salinas, California.

Remarks: The 1984 test results have good reliability. Except for two or three tests CV's were under 10% for yield components.

The assistance of Dr. F. J. Hills and Patricia Thomas, University of California at Davis, in the analyses of test data is gratefully acknowledged.

TEST 1284. ADVANCED HYBRID EVALUATION TEST, SALINAS, CA, 1984

16 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 18, 1984
Harvested: September 17-18, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
HH37	Holly 82-C93-02	13,424	36.73	18.33	0.7	0.6	147	3.07	85.7	314
USH11	(282110) C546H3 x C36	13,271	37.06	17.94	0.2	0.1	141	2.96	85.8	307
Y246H21	C301H72 x C46	13,246	37.77	17.60	0.0	0.0	121	2.93	85.7	301
3747H8	F78-546H3 x 2747	13,196	36.59	18.19	0.5	0.6	125	3.13	85.3	310
SS-NB2	Spreckels	13,164	35.80	18.47	0.4	0.3	139	3.34	84.8	312
E337H22	1546HL5 x F81-37	12,892	36.83	17.60	0.2	0.2	124	3.10	85.1	299
USC-3	83417	12,891	35.46	18.23	0.0	0.5	128	3.21	85.0	310
Y246H33	1546H72 x C46	12,812	34.87	18.44	0.0	1.1	124	3.28	84.9	313
Y346H8	F78-546H3 x F82-46	12,702	34.65	18.40	0.0	0.6	131	3.22	85.2	313
Y246H42	1546HL5 x C46	12,575	35.47	17.80	0.0	0.0	126	3.24	84.7	301
Y354H8	F78-546H3 x Y254	12,499	34.23	18.39	0.0	0.9	119	3.23	85.1	312
Y339H8	F78-546H3 x Y139	12,474	34.07	18.31	0.3	0.8	125	3.14	85.4	312
E337H8	F78-546H3 x F81-37	12,438	34.60	18.03	0.0	0.5	127	3.26	84.7	305
3902H8	F78-546H3 x 902	12,424	34.14	18.25	0.3	0.9	122	3.12	85.5	311
USC-1	83348	12,322	34.22	18.04	0.0	0.7	127	3.29	84.6	305
SS-Z1	Spreckels	11,680	32.23	18.21	0.2	0.8	132	3.29	84.7	308
Mean		12,751	35.29	18.14	0.2	0.5	129	3.18	85.1	308
LSD (.05)		549	1.67	0.58	0.5	NS	7	NS	NS	NS
C. V. (%)		4.3	4.8	3.23	265.5	193.8	5.7	9.1	1.4	3.8
F value		5.4**	5.9**	1.8*	1.9*	0.8 NS	8.8**	1.4 NS	0.9 NS	1.4 NS

Note: BWYV infection was moderate. PM was controlled with Bayleton and very minor. Nitrogen deficiency occurred late in the season.

[1/] 546H3 = C562CMS x C546. C301H72 = C718CMS x C301. 1546HL5 = C301CMS x C546. 1546H72 = C718CMS x C546.

TEST 1384. HYBRID EVALUATION TEST, SALINAS, CA, 1984

16 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 18, 1984
Harvested: September 19-20, 1984

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
E337H37	2807HO (C306) x F81-37	14,797	42.03	17.66	0.0	1.3	134	2.96	85.7	302
E337H16	2755HO x F81-37	14,461	40.15	18.03	0.2	1.0	128	2.98	85.9	309
E337H31	F82-301CMS x F81-37	14,242	41.11	17.36	0.0	0.4	121	2.84	86.0	298
Y346H31	F82-301CMS x F82-46	14,230	40.20	17.71	0.0	0.0	119	2.99	85.6	303
Y346H38	2808HO (C307) x F82-46	14,165	40.38	17.56	0.0	0.3	131	2.84	86.1	302
KW1132	Betaseed	14,098	36.86	19.16	2.6	3.5	131	3.03	86.4	330
E337H40	2810HO (C303) x F81-37	14,066	40.14	17.54	0.0	0.7	120	2.94	85.6	300
E337H36	2806HO (C305) x F81-37	14,046	40.03	17.57	0.0	0.0	131	3.12	84.9	298
E337H38	2808HO (C307) x F81-37	14,016	40.80	17.25	0.3	0.8	131	2.95	85.4	294
E337H35	2805HO (C304) x F81-37	13,979	40.04	17.49	0.0	0.5	133	3.01	85.4	298
Y346H64	1216aa x F82-46	13,946	39.45	17.73	0.0	0.5	119	3.02	85.5	302
USH11	(282110) 546H3 x C36	13,770	39.60	17.40	0.0	0.3	135	2.86	86.0	298
Y346H37	2807HO (C306) x F82-46	13,701	38.90	17.62	0.0	1.0	132	3.10	85.0	299
E337H8	F78-546H3 x F81-37	13,590	38.81	17.53	0.0	1.0	135	2.88	85.9	301
E337H39	2809HO (C302) x F81-37	13,476	38.46	17.62	0.0	0.9	119	2.96	85.7	301
Y346H8	F78-546H3 x F82-46	13,345	37.83	17.67	0.0	0.8	130	3.01	85.5	302
Mean		13,996	39.67	17.68	0.2	0.8	128	2.97	85.6	302
LSD (.05)		686	2.10	0.42	0.6	1.2	7	NS	NS	7
C. V. (%)		4.9	5.4	2.4	332.7	144.3	5.6	9.1	1.1	2
F value		2.2**	2.9**	8.4**	8.1**	3.8**	5.9**	0.7 NS	1.1 NS	10.4**

Note: See note for test 1284.

[1/] 2755HO = CMS of mm, S^f, A:aa population.

TEST 1584. HYBRID EVALUATION OF GERMPLASM LINES, SALINAS, CA, 1984

16 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 19, 1984
Harvested: September 21, 1984

Variety	Description[1/]	Acre Yield		Sucrose	Bolting	Root Rot	Beets/ 100'
		Sugar	Beets				
		Lbs	Tons	%	%	%	Number
3902H72	C718HO x Y254H53	15,140	42.89	17.66	0.0	0.3	125
3755JH67	2747aa x 0755-S_1(CO)	14,687	42.03	17.49	0.6	0.3	132
3755KH67	2747aa x 0755-S_1(SY)	14,529	41.87	17.46	0.0	0.7	130
3747H55	2755aa x 2747	14,301	40.38	17.74	0.9	0.0	133
Y339H67	2747aa x Y139	14,224	38.61	18.43	0.0	0.4	116
3755JH69	1219aa x 0755-S_1(CO)	14,025	39.50	17.77	0.7	0.4	122
3755JH71	1221aa x 0755-S_1(CO)	13,936	38.99	17.94	0.7	0.7	126
3902H55	2755aa x Y254H53	13,908	38.59	18.05	0.0	0.0	136
3755JH68	1218aa x 0755-S_1(CO)	13,818	39.14	17.73	0.3	0.3	122
USH11	282110	13,806	38.50	17.98	0.0	0.0	134
Y346H8	F78-546H3 x F82-46	13,648	37.54	18.27	0.0	0.0	127
3902H8	F78-546H3 x Y254H53	13,643	38.52	17.73	0.0	0.0	127
E337H8	F78-546H3 x F81-37	13,587	38.22	17.78	0.0	0.0	130
Y346H96	1796aa x F82-46	13,558	37.57	18.06	0.0	0.3	124
Y346H73	2733aa x F82-46	13,439	36.59	18.40	0.0	0.4	115
3755JH70	1220aa x 0755-S_1(CO)	13,061	36.80	17.77	0.0	0.0	122
Mean		13,957	39.11	17.89	0.2	0.2	126
LSD (.05)		911	2.61	0.40	NS	NS	9
C. V. (%)		6.6	6.8	2.2	404.1	376.7	7.6
F value		2.6**	3.9**	4.3**	1.3 NS	0.6 NS	3.4**

[1/] Y254H53, 2747, 1218, 1219, 1220, 1221 are MM, S^f, A:aa populations being developed for disease resistance and MM components of reciprocal recurrent selection evaluations. 1796, 2733, and 755 are mm, S^f, A:aa populations. 1796 is similar to C796. Lines C301-C308 were extracted from 755. Y139 is a broadbased MM, O.P. population.

TEST 1684. EVALUATION OF HYBRIDS WITH HIGH AND LOW % SUGAR, SALINAS, CA, 1984

8 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: October 4, 1984

Variety	Description1/	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100 Number	Non Sucrose SS %	Raw J. App. Purity %	Extract Sugar Lbs/T
KW1132	Betaseed 3044-1	12,516	34.22	18.28	2.0	123	2.52	87.9	321
Y246H55-40	1755-40aa x Y146	12,135	36.89	16.44	0.3	124	2.64	86.2	283
E137HL45-46	0755-46aa x F80-37	11,844	32.91	18.01	0.0	114	2.80	86.6	311
Y246H55-35	1755-35aa x Y146	11,728	33.59	17.49	0.3	131	2.64	86.9	304
USH11	(282110) 546H3 x C36	11,565	34.85	16.63	0.0	125	2.47	87.1	289
Y346H8	F78-546H3 x F82-46	11,482	33.70	17.03	0.0	120	2.71	86.3	293
Y339H55	2755aa x Y139	11,440	32.59	17.56	0.0	126	2.69	86.7	304
Monodoro	Hilleshog Rzm tol.	11,057	32.22	17.13	0.0	119	2.85	85.7	293
Mean		11,721	33.87	17.32	0.3	123	2.67	86.7	300
LSD (.05)		NS	3.10	0.47	0.9	NS	NS	NS	11
C. V. (%)		9.3	9.1	2.7	280.4	10.8	13.2	1.8	3.5
F value		1.4 NS	1.9 NS	14.6**	4.4**	1.1 NS	1.1 NS	1.3 NS	11.0**

1/ 0755-46 is a line resistant to Erwinia to be released in 1985 as C309.

TEST 2384. STRIP HYBRID TEST, SALINAS, CA, 1984

14 entries x 4 reps
2-row plots, 150 ft. long

Planted: March 9, 1984
Harvested: October 19, 25-26, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %
Y346H37	2807HO x F82-46	12,179	36.74	16.62	0.5
3747H55	2755aa x F81-37	12,138	36.60	16.55	0.0
KW1132	Betaseed	11,755	32.95	17.85	2.0
3902H55	2755aa x Y254H53	11,618	34.70	16.74	2.3
USH11	(282110)	11,615	35.09	16.56	0.5
E337H31	F82-301CMS x F81-37	11,587	35.07	16.46	1.0
USC-2	(83048)	11,430	34.45	16.56	0.5
Y346H31	F82-301CMS x F82-46	11,417	34.15	16.76	0.8
HH37	Holly	11,384	33.84	16.77	0.8
Y339H8	F78-546H3 x Y139	11,366	32.54	17.51	1.5
USC-3	(83417)	11,247	33.42	16.78	2.0
Monodoro	Hilleshog	11,128	32.94	16.94	0.8
E337H37	2807HO x F81-37	11,009	33.37	16.47	1.3
USC-1	(83348)	10,959	32.27	17.03	1.5
Mean		11,488	34.15	16.83	1.1
LSD (.05)		NS	NS	NS	NS
C. V. (%)		8.9	7.3	3.8	108.4
F value		0.5 NS	1.2 NS	1.6 NS	1.3 NS

[1/] 2807 = C306.

Note: Test 2384 was planted in a buffer area between the noninoculated yield tests and the BWYV inoculated yield tests. The incidence of natural BWYV infection increased through the season. The reliability of test 2384 is poor to fair.

TEST 1184-1. CODED VARIETY TRIAL #1: AREA 4, SALINAS, CA, 1984

12 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 18, 1984
Harvested: September 18-19, 1984

Variety	Description	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolters %	Root Rot[1] %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
4654	Betaseed	14,949	41.76	17.94	0.2	4.3	128	2.77	86.7	310
HH 37	Holly	14,624	38.26	19.14	0.3	0.3	132	3.02	86.4	330
SS-NB2	Spreckels	14,572	38.71	18.84	0.3	0.3	124	3.01	86.3	324
3X8814	Betaseed	14,516	39.70	18.37	0.2	3.4	120	2.82	86.7	318
2C0105	Betaseed	14,166	39.31	18.04	0.5	6.8	122	2.73	86.9	313
83C117-04	Holly	14,164	38.54	18.41	1.1	0.3	132	2.91	86.4	317
83C117-05	Holly	14,030	37.55	18.70	0.3	0.5	132	3.01	86.2	322
USC-3	Union	14,006	38.06	18.48	0.3	1.6	118	2.82	86.9	320
USC-1	Union	13,985	37.90	18.47	0.0	0.5	128	2.98	86.1	318
US H11	Std. check	13,566	37.28	18.21	0.0	0.3	122	2.89	86.3	314
SS-Z1	Spreckels	13,263	36.13	18.37	0.0	1.6	124	3.19	85.2	313
USC-2	Union	13,106	36.89	17.81	0.0	1.6	128	2.86	86.2	307
Mean		14,079	38.34	18.40	0.3	1.8	126	2.92	86.3	317
LSD (.05)		905	3.09	0.63	0.7	2.0	9	NS	NS	11
C. V. (%)		6.5	8.1	3.5	244.6	113.5	7.5	10.2	1.2	3
F value		3.0**	1.8 NS	2.8**	1.8 NS	7.9**	2.1*	1.6 NS	1.5 NS	2.8**

[1] Roots with rot counted at harvest. Rot probably due to Erwinia.

TEST 1184-2. CODED VARIETY TRIAL #2: AREA 4, SALINAS, CA, 1984

12 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: September 27-28, 1984

Variety	Description	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
4654	Betaseed	12,232	35.62	17.20	1.4	123	2.74	86.3	296
2C0105	Betaseed	11,869	34.83	17.03	2.2	124	2.65	86.5	294
HH 37	Holly	11,705	33.22	17.63	0.0	128	2.82	86.2	303
SS-NB2	Spreckels	11,681	33.01	17.71	0.7	129	2.79	86.4	305
83C117-05	Holly	11,629	33.61	17.31	0.2	131	2.77	86.2	298
83C117-04	Holly	11,572	33.53	17.34	0.0	126	2.79	86.2	298
3X8814	Betaseed	11,560	34.03	16.98	1.4	125	2.58	86.8	294
USC-3	Union	11,509	32.87	17.54	0.2	120	2.88	85.9	301
US H11	Std. check	11,325	32.81	17.28	0.2	119	2.85	85.9	296
USC-1	Union	11,236	32.75	17.14	0.2	123	2.84	85.8	294
USC-2	Union	11,001	31.88	17.26	0.4	130	2.88	85.7	295
SS-Z1	Spreckels	10,695	30.23	17.72	0.7	124	2.85	86.2	305
Mean		11,501	33.20	17.34	0.6	125	2.79	86.2	298
LSD (.05)		678	2.31	NS	1.0	7	NS	NS	NS
C. V. (%)		5.9	7.0	3.4	158.6	5.4	9.5	1.1	3.4
F value		2.8**	2.8**	1.5 NS	4.1**	2.3*	1.0 NS	0.9 NS	1.4 NS

TEST 2584. VIRUS YELLOWS CODED VARIETY TRIAL, SALINAS, CA, 1984

21 entries x 8 reps, RCB
1-row plots, 60 ft. long

Planted: April 11, 1984
Harvested: October 15-16, 1984

Variety	Description	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T	Virus Yellows Score 8/22/84	Virus Yellows Score 8/29/84
4654	Betaseed	8,090	27.49	14.70	2.1	120	3.64	80.1	235	4.0	4.6
3X8814	Betaseed	8,044	26.72	15.06	1.8	121	3.61	80.7	242	4.3	5.1
2C0105	Betaseed	7,796	26.48	14.72	1.6	115	3.75	79.7	234	4.6	5.5
83C21-08	Holly	7,614	24.11	15.80	0.8	107	3.68	81.1	256	4.1	4.8
USC-3	Union	7,593	24.82	15.26	0.4	115	3.56	81.0	247	3.6	4.4
HH 37	Holly	7,551	24.28	15.55	0.7	115	3.64	81.0	252	4.0	4.6
83C117-04	Holly	7,480	24.04	15.55	0.4	115	3.77	80.5	250	4.1	4.4
815323-02	Holly	7,457	23.19	16.09	0.0	108	3.69	81.4	261	3.3	3.9
SS-NB2	Spreckels	7,416	24.43	15.20	1.7	126	3.67	80.6	244	4.3	5.3
HH 38	Holly	7,391	23.36	15.83	0.0	106	3.47	82.0	259	4.8	5.4
83C117-05	Holly	7,302	23.44	15.59	0.0	111	3.70	80.8	252	3.8	4.5
USC-2	Union	7,240	23.50	15.40	0.0	118	3.75	80.4	247	3.9	4.6
USC-1	Union	7,120	22.81	15.61	1.2	107	3.68	81.0	252	4.1	4.9
817335-06	Holly	7,108	22.44	15.83	0.4	109	3.60	81.5	258	4.0	4.4
HH 40	Holly	7,090	22.37	15.83	0.0	122	3.60	81.5	258	4.3	4.9
83C210-12	Holly	7,039	22.08	15.91	0.7	121	3.52	81.9	260	4.4	5.4
US H11	Std. check	7,038	23.10	15.24	0.0	122	3.61	80.8	246	3.9	4.6
83C116-02	Holly	6,999	22.48	15.55	0.4	112	3.88	80.1	249	4.8	5.3
HH 27	Holly	6,919	21.48	16.09	0.4	101	3.90	80.5	259	5.3	6.3
SS-Z1	Spreckels	6,702	21.97	15.28	0.4	108	3.85	79.9	244	4.6	5.5
HH 23	Holly	6,697	21.32	15.68	1.1	109	3.76	80.6	252	4.8	5.6
Mean		7,318	23.62	15.51	0.7	114	3.68	80.8	250	4.2	4.9
LSD (.05)		523	1.70	0.51	1.4	9.1	NS	1.4	10	0.4	0.6
C. V. (%)		7.2	7.3	3.3	216.6	8.1	8.3	1.7	4.3	9.9	11.9
F value		4.2**	7.6**	4.6**	1.7*	4.2**	1.1 NS	1.6*	4.0**	9.5**	7.1**

Note: Test was designed as a split-block with BWYV inoculated and noninoculated blocks. Inoculated with BWYV June 13, 1984. However, BWYV spread uniformly across all blocks, so test was harvested as RCB. Incidence of BWYV was high.

TEST 2684. PERFORMANCE OF HYBRIDS UNDER VIRUS YELLOWS (BWYV) INFECTED CONDITIONS, SALINAS, CA, 1984

16 entries x 8 reps, RCB
1-row plots, 63 ft. long

Planted: April 12, 1984
Harvested: October 22, 23, 1984

Variety	Description[1]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Yellows[2] Score 8/22	Yellows Score 8/29
E337H47	C306aa x F81-37	8,557	28.00	15.32	2.6	115	5.0	5.5
Y231H16	0755HO x Y131	8,474	28.75	14.78	0.4	109	4.0	4.5
Y339H8	F78-546H3 x Y139	8,152	26.04	15.69	2.0	108	6.5	7.3
Y346H64	1216aa x F82-46	8,074	26.20	15.42	0.0	104	5.0	6.0
3902H55	2755aa x Y254H53	8,057	26.94	14.93	1.1	119	5.3	6.3
Y346H55	2755aa x F82-46	7,933	26.21	15.13	1.1	110	1.8	2.3
E337H55	2755aa x F81-37	7,852	26.16	15.02	0.0	114	3.0	3.0
Y346H31	F82-301CMS x F82-46	7,636	25.94	14.72	0.9	103	2.8	3.0
Y346H96	C796aa x F82-46	7,599	25.72	14.84	1.9	108	4.5	5.8
3747H55	2755aa x 2747	7,476	25.68	14.57	1.1	113	2.5	2.8
E337H8	F78-546H3 x F81-37	7,458	24.95	15.00	1.2	108	4.3	4.5
Y346H8	F78-546H3 x F82-46	7,264	23.44	15.50	0.4	98	5.5	6.5
KW1132	Betaseed Lot 3044-1	7,243	23.33	15.53	4.6	110	7.0	8.5
USH11	Lot 282110	7,214	24.32	14.82	0.4	112	3.0	3.3
E337H49	C307aa x F81-37	6,785	22.55	15.03	1.0	88	2.5	2.8
Mono1167	Hilleshog Rhizom. Res.	6,410	21.80	14.70	2.0	109	6.3	7.3
Mean		7,637	25.38	15.06	1.3	108	4.3	4.9
LSD (.05)		590	1.93	NS	2.01	3.27	NS	NS
C. V. (%)		7.8	7.7	5.6	157.5	3.1	50.8	50.6
F value		7.6**	7.6**	1.3 NS	2.6**	9.5**	1.1 NS	1.2 NS

1/ F81-37 = C37. Y131 = C31/4. F82-46 = C46. 2747 = S^f, M, A:aa. 755 = S^f, mm, A:aa.

2/ Virus yellows scores rated from 0 to 9 where 0 = green, 9 = 100% of recently matured leaves yellowed.

Note: Test was designed as a split-block with inoculated and noninoculated treatments. Natural BWYV infection occurred uniformly across all treatments after inoculation (June 13). The test was harvested as a RCB design. Test should have high reliability under BWYV infected conditions.

TEST 2784. PERFORMANCE OF MULTIGERM, O.P. GERMPLASM UNDER VIRUS YELLOWS (BWYV) INFECTED CONDITIONS, SALINAS, CA, 1984

16 var x 8 reps
1-row plots, 63 ft. long

Planted: April 12, 1984
Harvested: October 23-24, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolters %	Root Rot %	Beets/ 100' Number	Yellows Score 8/22	Yellows Score 8/29
Y339H67	2747aa x Y139	9,934	30.50	16.30	0.3	0.7	118	2.3	3.3
Y339 (Iso)	YR-ER Y139	9,421	27.26	17.29	1.8	0.7	116	5.3	6.0
Y341	YR-ER Y141 (Iso)	9,285	27.55	16.88	0.0	0.0	114	2.0	2.3
3902 (Sp)	Y254H53aa x A	9,243	29.67	15.56	0.0	0.0	115	4.3	5.0
Y347	YR-ER Y147	9,242	27.99	16.53	0.0	0.0	115	3.0	3.8
Y352	YR-ER Y152	9,229	27.79	16.61	0.0	1.8	118	3.0	4.0
3747 (Sp)	2747aa x A	9,185	28.86	15.93	0.0	0.0	128	3.8	4.5
Y331	YR-ER Y131 (Iso)	9,105	26.82	16.98	0.0	0.0	116	3.8	4.8
Y246H53	1747,8aa x Y146	9,002	28.31	15.93	0.0	0.4	114	3.8	5.0
Y348	YR-ER Y148	8,875	26.74	16.64	0.4	0.0	113	2.8	2.8
Y349	YR-ER Y149	8,830	27.20	16.24	0.0	0.0	114	1.8	2.3
Y354	Inc. Y254	8,753	27.23	16.09	0.0	1.1	112	2.5	3.0
F83-46	Inc. F82-46 (83010)	7,699	24.25	15.87	0.0	0.4	103	2.8	3.8
F81-37	Inc. C37 (81101)	7,602	23.96	15.83	0.0	0.3	123	3.0	3.5
968	Inc. 468 (US75)	6,284	21.97	14.34	0.0	0.4	104	5.0	5.5
SP6822-0	Lot 6519	5,557	18.66	14.88	0.9	2.1	97	8.8	9.3
Mean		8,578	26.55	16.12	0.2	0.5	114	3.6	4.3
LSD (.05)		586	1.66	0.68	0.66	1.12	3.99	NS	NS
C. V. (%)		6.9	6.3	4.3	312.7	225.2	3.6	54.8	53.6
F value		32.8**	25.7**	9.7**	4.2**	2.7**	7.0**	1.4 NS	1.1 NS

1/ Y39, Y41, Y47, Y48, Y49, Y52 and Y54 = MM, $S^{s}S^{s}$ lines in various stages of improvement for multiple disease resistance and sucrose content. 747, 902, and Y246H53 = MM, S^{f} populations that segregate for genetic m.s. F83-46 = C46. Y331 = C31/5. F81-37 = C37. 968 = Inc. US 75.

Note: See note for test 2684.

TEST 2484. PERFORMANCE OF MONOGERM GERMPLASM UNDER VIRUS YELLOWS (BWYV) INFECTED CONDITIONS, SALINAS, CA, 1984

10 entries x 8 reps
1-row plots, 63 ft. long

Planted: April 11, 1984
Harvested: October 24-25, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Yellows Score 8/22	Yellows Score 8/29
3107H55	2755aa x PI69-81	7,965	24.17	16.47	0.7	116	4.8	6.0
3218-21	YR-ER 1218,19,20,21 C1(A, aa)	6,888	22.68	15.21	0.8	117	3.3	3.8
2790	1790 (Iso) aa x A	6,468	21.56	14.99	0.8	112	3.3	3.3
3743HO	0740-5HO x 2741-5	6,282	21.09	14.88	1.2	107	3.8	4.5
3755K	0755-S_1(SY) aa x A	6,060	21.26	14.26	0.7	117	6.0	6.8
3796	YR-ER 1796 (A, aa)	5,874	19.88	14.74	1.0	126	2.0	2.3
3755Z	YR-ER (%S) 1755 Iso (A, aa)	5,572	18.09	15.40	0.3	121	3.0	3.8
F82-546H3	(82460)	5,391	18.38	14.66	0.5	96	3.8	4.3
3217A	YR-ER 1217 (A, aa)	5,309	18.14	14.62	0.9	109	6.3	8.3
3796A (Iso)	Inc. T-0 2796-S_1(A, aa)	4,890	17.33	14.12	0.7	122	5.0	5.5
Mean		6,070	20.26	14.93	0.7	114	4.1	4.8
LSD (.05)		657	2.02	0.60	NS	3.73	NS	0.0
C. V. (%)		10.8	10.0	4.0	195.5	3.3	57.3	57.5
F value		14.8**	10.0**	9.7**	0.2 NS	11.1**	0.7 NS	0.8 NS

1/ PI69-81 = PI467869-PI467881 from China. 3218-21 = Composite of S^f, MM, A:aa lines. 2790, 3743, 3755K, 3755Z, 3796, 3796A, and 3217A = S^f, mm, A:aa populations. 3796A = C796. F82-546H3 = C562CMS x C546.

Note: See note for test 2684. This test has only fair reliability.

TEST 1084-1. GCA OF CO:C1 SYNTHETICS C, D AND E OF POPULATION 755, SALINAS, CA, 1984

4 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 18, 1984
Harvested: September 19, 1984

Variety	Description[1/]	Acre Yield Sugar lbs	Acre Yield Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract Sugar lbs/T
Y346H56	2755Caa x F82-46	13,554	37.73	17.98	0.0	1.2	116	3.10	85.3	306
Y346H55	2755aa x F82-46	13,327	36.51	18.26	0.0	0.2	126	3.14	85.4	311
Y346H57	2755Daa x F82-46	13,215	36.39	18.24	0.2	0.2	118	3.23	85.0	309
Y346H58	2755Eaa x F82-46	13,079	35.08	18.65	0.2	0.2	128	3.12	85.7	319
Mean		13,294	36.43	18.28	0.1	0.4	122	3.15	85.3	312
LSD (.05)		NS	NS	NS	NS	NS	6.7	NS	NS	9.6NS
C. V. (%)		6.1	5.9	3.2	411.4	216.6	5.2	9.20	1.1	3.0
F value		0.5NS	2.0NS	1.8NS	0.6NS	2.5NS	6.6**	0.3NS	0.8NS	2.8NS

1/See footnote 1, Test 984-1. In 1983, synthetics C, D, and E and popn 2755 were topcrossed to C46 to produce variety hybrids and these were tested in 1984 to measure the response to a 20% selection intensity.

TEST 1484. HYBRID EVALUATION OF C301 THROUGH C307, SALINAS, CA, 1984

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 19, 1984
Harvested: September 24-25, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
3747H31	F82-301CMS x 2747	14,606	42.52	17.21	0.6	0.0	133	3.09	84.81	291.91
Y346H72	C718HO x F82-46	14,471	40.71	17.81	0.0	0.6	136	2.84	86.26	307.14
Y354H31	F82-301CMS x Y254	14,404	41.25	17.56	0.0	0.4	129	3.16	84.82	297.71
Y246H61	C301aa x C46	14,310	40.27	17.78	0.3	0.3	137	3.27	84.48	300.44
E337H23	1546H72 x F81-37	14,186	40.58	17.49	0.0	0.3	125	3.00	85.38	298.66
USH11	(282110) 546H3 x C36	14,162	39.88	17.79	0.3	0.0	143	3.11	85.17	302.94
Y346H31	F82-301CMS x F82-46	14,131	40.55	17.48	0.9	0.6	134	3.04	85.16	297.85
E337H48	2808aa (C307) x F81-37	14,100	40.92	17.28	0.4	0.0	107	2.84	85.91	296.85
E137HL6	C301aa x F80-37	13,980	40.65	17.20	0.0	0.4	125	3.13	84.63	291.14
U'mono	Ultramono	13,947	34.80	20.07	0.0	1.6	135	3.32	85.85	344.49
E337H72	C718HO x F81-37	13,876	40.14	17.31	0.0	0.0	132	3.10	84.80	293.60
3902H31	F82-301CMS x 902	13,847	39.75	17.45	0.4	0.0	129	2.99	85.37	297.93
BJ 19	Bush Johnson's	13,826	35.87	19.30	0.6	0.9	133	3.39	85.07	328.31
E337H31	F82-301CMS x F81-37	13,826	39.68	17.46	0.0	0.4	125	3.06	85.09	297.07
E337H50	2810aa (C303) x F81-37	13,803	38.86	17.81	0.0	1.4	123	3.28	84.45	300.87
E337H21	C301H72 x F81-37	13,700	40.48	16.98	0.0	0.3	130	2.98	85.13	289.11
Y346H55	2755aa x F82-46	13,621	38.28	17.85	0.0	0.9	130	3.20	84.80	302.75
E337H8	F78-546H3 x F81-37	13,514	37.86	17.88	0.0	0.0	133	3.26	84.57	302.39
E337H46	2806aa (C305) x F81-37	13,505	39.36	17.17	0.0	0.0	129	3.14	84.53	290.30
Y346H3	C562HO x F82-46	13,498	37.84	17.85	0.0	0.3	135	3.04	85.43	305.03

TEST 1484. HYBRID EVALUATION OF C301 THROUGH C307, SALINAS, CA, 1984 (Cont'd)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 19, 1984
Harvested: September 24-25, 1984

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
3902H55	2755aa x 902	13,469	37.22	18.13	0.3	1.0	126	3.19	85.04	308.38
E337H49	2809aa (C302) x F81-37	13,434	38.21	17.62	0.0	0.7	134	3.13	84.93	299.23
E337H47	2807aa (C306) x F81-37	13,340	37.99	17.56	0.0	1.0	130	3.18	84.66	297.43
E337H45	2805aa (C304) x F81-37	13,307	37.26	17.88	0.0	0.0	128	3.12	85.18	304.57
E337H42	2802aa x F81-37	13,298	38.42	17.42	0.0	0.4	132	2.96	85.53	297.86
3747H55	2755aa x 2747	13,268	36.93	18.00	0.0	0.0	131	3.14	85.17	306.59
Y346H42	2802aa x F82-46	13,222	37.41	17.73	0.0	0.0	128	3.02	85.48	303.12
Y339H55	2755aa x Y139	13,218	35.48	18.67	1.6	0.0	131	3.47	84.35	314.91
E337H55	2755aa x F81-37	13,061	37.51	17.48	0.0	0.0	132	3.07	85.13	297.45
E337H3	C562H0 x F81-37	12,988	36.81	17.66	0.0	0.0	130	3.24	84.50	298.50
Y354H55	2755aa x Y254	12,983	36.65	17.81	0.0	1.3	126	3.24	84.68	301.54
Y346H8	F78-546H3 x F82-46	12,962	35.55	18.26	0.0	0.0	129	3.38	84.39	308.10
Mean		13,683	38.61	17.78	0.2	0.4	130	3.14	85.02	302.32
LSD (.05)		971	3.45	0.77	0.6	1.0	9	0.30	1.02	13.13
C. V. (%)		7.2	9.1	4.40	362.0	255.9	7	9.7	1.20	4.40
F value		1.8**	2.5**	4.9**	2.6**	1.7**	2.9**	1.9**	1.6*	5.2**

Note: See note for test 1284.

[1/] 1546H72 = C718CMS x C546.

TEST 1784. RETEST OF LINES EXTRACTED FROM POPULATION 755 AFTER S_1-TX EVALUATION, SALINAS, CA, 1984

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: September 25, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
E137HL6	C301aa x F80-37	13,088	39.10	16.75	0.0	119	2.61	86.5	289
E337H48	C307aa x F81-37	13,013	38.04	17.13	0.0	118	2.61	86.8	297
E337H47	C306aa x F81-37	12,838	37.45	17.14	0.7	124	2.55	87.1	298
E337H46	C305aa x F81-37	12,783	37.48	17.06	0.0	125	2.80	85.9	293
E337H50	C303aa x F81-37	12,770	36.85	17.35	0.0	114	2.64	86.8	301
E337H45	C304aa x F81-37	12,716	35.88	17.74	0.7	129	2.80	86.4	306
E137HL45-46	C309aa x F80-37	12,663	34.49	18.36	0.0	107	3.17	85.3	313
E337H55	2755aa x F81-37	12,649	36.31	17.44	0.0	125	2.81	86.1	300
E337H40	C303CMS x F81-37	12,649	37.54	16.87	1.1	119	2.76	85.9	289
E337H49	C302aa x F81-37	12,550	36.22	17.34	0.3	121	2.54	87.3	302
E137HL45-51	755-51aa x F80-37	12,545	37.68	16.66	0.7	119	2.63	86.4	287
E337H39	C302CMS x F81-37	12,520	36.52	17.16	0.0	116	2.61	86.8	298
E337H36	C305CMS x F81-37	12,510	36.95	16.94	1.2	115	2.71	86.2	292
E337H38	C307CMS x F81-37	12,458	37.41	16.66	0.0	127	2.68	86.2	287
USH11	C546H3 x C36	12,444	36.74	16.98	0.0	124	2.68	86.4	293
E337H72	C718CMS x F81-37	12,407	37.36	16.60	0.7	120	2.66	86.2	286
E137HL45-70	755-70aa x F80-37	12,312	35.72	17.24	0.3	119	2.70	86.5	298
E337H37	C306CMS x F81-37	12,310	35.99	17.12	0.0	120	2.77	86.1	294
3902H55	2755aa x Y254H53	12,294	34.92	17.62	1.1	121	2.71	86.7	305
Y346H38	C307CMS x F82-46	12,285	36.38	16.91	0.4	123	2.61	86.6	292

TEST 1784. RETEST OF LINES EXTRACTED FROM POPULATION 755 AFTER S_1-TX EVALUATION, SALINAS, CA, 1984 (Cont'd.)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: September 25, 1984

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	Number	%	%	Lbs/T
Y346H37	C306CMS x F82-46	12,264	35.91	17.12	0.7	123	2.67	86.5	296
E337H4	C563CMS x F81-37	12,136	35.87	16.95	0.0	127	2.54	86.9	294
E137HL45-26	755-26aa x F80-37	12,109	34.92	17.35	0.3	105	2.59	87.0	301
E337H31	C301CMS x F81-37	12,093	36.75	16.46	0.4	122	2.58	86.5	284
E337H35	C304CMS x F81-37	12,060	35.75	16.89	0.3	118	2.66	86.4	291
Y346H8	C546H3 x F82-46	11,996	34.47	17.40	0.4	123	2.77	86.3	300
E337H8	C546H3 x F81-37	11,994	34.85	17.21	0.0	118	2.72	86.4	297
E137HL16-18	755-18aa x C37	11,956	35.07	17.04	0.4	114	2.69	86.4	294
Ultramono	Maribo	11,882	31.05	19.14	2.5	113	2.98	86.5	331
Y339H55	2755aa x Y139	11,774	33.09	17.82	0.3	119	2.70	86.8	309
E137HL45-22	755-22aa x F80-37	11,717	32.69	17.93	0.4	111	3.21	84.8	304
E137HL16-43	C308aa x C37	11,446	31.60	18.13	1.8	101	2.88	86.3	312
Mean		12,351	35.84	17.27	0.5	119	2.72	86.4	298
LSD (.05)		785	2.33	0.59	1.2	10	0.20	0.89	11
C. V. (%)		6.5	6.6	3.4	255.5	8.9	7.4	1.00	3.9
F value		1.9**	4.7**	7.0**	1.9**	2.8**	4.9**	2.3**	5.3**

[1/] 2755 = advanced random-mating mm, S^f, A:aa population. C301-C309 = increases of S_1 lines extracted from earlier cycles of 755 population. C301-C308 and 755-18 from 8755. C309 and 755-26, -51, -70, -22 from 9755. C301-C307 tested as both aa and CMS versions with C37.

Note: Powdery mildew controlled with Bayleton. BWYV incidence and severity moderate. Root rot counted at harvest and probably due to Erwinia.

SPENCE 1884: RETEST OF Y246H55, Y246H57 & Y246H59; S_1-TX PROGENIES OF 755, 757, and 742, SALINAS, CA, 1984

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: October 1-2, 1984

Variety	Description[1/]	Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Sugar Lbs	Beets Tons	%	%	Number	%	%	Lbs/T
Y246H57-5	1757-5aa x Y146	12,680	36.40	17.42	0.0	125	2.84	86.0	299
Y246H55-50	1755-50aa x Y146	12,184	35.55	17.16	1.1	118	2.67	86.5	296
Y246H57-7	1757-7aa x Y146	12,107	35.38	17.14	0.0	114	2.99	85.1	291
USH11	(282110) C546H3 x C36	12,084	34.90	17.33	0.0	128	2.83	86.0	297
Y246H57-29	1757-29aa x Y146	12,076	34.53	17.52	0.0	116	3.19	84.6	296
Y246H57-2	1757-2aa x Y146	12,036	33.90	17.78	0.3	126	2.95	85.8	304
Y246H55-4	1755-4aa x Y146	12,013	33.51	17.94	0.0	123	3.10	85.3	306
Y246H57-25	1757-25aa x Y146	12,012	34.82	17.24	0.0	116	2.90	85.6	295
Y246H54	1755aa x Y146	11,980	33.89	17.69	0.3	125	3.00	85.5	302
Y246H59-45	1742-45aa x Y146	11,920	34.69	17.18	0.9	106	2.64	86.7	297
Y246H57-17	1757-17aa x Y146	11,880	33.76	17.59	0.3	114	2.94	85.7	301
Y246H57-35	1757-35aa x Y146	11,861	34.11	17.40	0.4	123	2.83	86.0	299
Y246H59-24	1742-24aa x Y146	11,850	32.84	18.05	0.5	100	3.04	85.6	308
Y246H59-31	1742-31aa x Y146	11,845	35.19	16.84	0.4	126	2.73	86.1	289
Y246H55-23	1755-23aa x Y146	11,845	33.34	17.78	0.6	129	2.86	86.2	306
Y246H55-63	1755-63aa x Y146	11,826	33.61	17.59	1.0	127	3.08	85.1	299
Y246H55-57	1755-57aa x Y146	11,804	34.59	17.09	0.0	126	2.84	85.8	293
Y246H72	C718HO x Y146	11,772	34.47	17.09	0.0	116	2.71	86.3	294
Y246H55-37	1755-37aa x Y146	11,768	33.49	17.60	0.0	130	2.88	86.0	302
Y246H57-9	1757-9aa x Y146	11,715	33.08	17.69	0.0	121	3.11	85.0	300

SPENCE 1884: RETEST OF Y246H55, Y246H57 & Y246H59; S_1-TX PROGENIES OF 755, 757, and 742, SALINAS, CA, 1984 (Cont'd.)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: October 1-2, 1984

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
Y246H55-21	1755-21aa x Y146	11,707	32.84	17.87	0.0	127	2.84	86.3	308
Y246H55-40	1755-40aa x Y146	11,590	33.98	17.08	0.0	116	2.90	85.4	292
Y246H57-23	1757-23aa x Y146	11,515	33.22	17.35	0.0	130	2.75	86.3	299
Y246H55-5	1755-5aa x Y146	11,500	32.20	17.88	0.7	107	2.80	86.5	309
Y246H55-9	1755-9aa x Y146	11,479	32.34	17.75	0.0	115	2.97	85.7	304
Y246H55-35	1755-35aa x Y146	11,354	31.56	18.01	0.3	129	3.01	85.7	308
Y246H57-13	1757-13aa x Y146	11,315	33.61	16.84	0.0	117	2.94	85.2	286
Y246H4	F67-563H0 x Y146	11,277	32.61	17.29	0.0	116	2.84	85.9	297
Y246H55-53	1755-53aa x Y146	11,202	31.86	17.61	0.7	126	3.02	85.3	300
Y246H58	0742aa x Y146	11,098	32.29	17.23	0.0	116	2.99	85.2	293
Y246H8	F78-546H3 x Y146	10,794	30.69	17.63	0.4	116	3.10	85.0	299
Y246H59-10	1742-10aa x Y146	10,794	31.20	17.32	0.0	100	2.71	86.5	299
Mean		11,715	33.58	17.47	0.3	119	2.91	85.7	299
LSD (.05)		863	2.74	0.57	NS	11	0.24	1.0	11
C. V. (%)		7.5	8.3	3.3	367.6	9.5	8.3	1.1	3.6
F value		1.7**	1.8**	2.6**	1.1 NS	4.2**	2.7**	2.3**	2.3**

Note: See note for test 1784.

[1/] In 1982, S_1 families from populations 755, 757, and 742 were topcrossed to C46 (Y146). These topcrosses were identified as hybrids Y246H55, Y246H57, and Y246H59, respectively, and were evaluated in progeny tests in 1983. On the basis of these early generation progeny tests, the superior S_1-TX's were retested in 1984. Seed of the original S_1-TX families was used. Check entries were USH11, Y246H8 = 546H3 x C46, Y246H4 = C563 x C46, and Y246H72 = C718 x C46. Check populations were: 1755 = C4 by mass selection from CO of 755; 0757 = C3 and O-type selection from CO-755; 0742 = mm, O-type, S^f, A:aa population different from 755 and 790. S_1 lines were randomly extracted from these populations for testing.

TEST 884-1. PERFORMANCE AND CA OF CO:C1 SYNTHETICS OF 755 POPULATIONS, SALINAS, CALIFORNIA, 1984

4 popn x 2 trmts x 8 reps., split-plot
2-row plots, 30 ft. long

Planted: January 17, 1984
Harvested: September 12, 1984

Variety	Description[1/]	Acre Yield: Sugar Actual	Sugar Change	Beet Actual	Beet Change	Sucrose Actual	Sucrose Change	Bolters	Root Rot	Beets/ 100'
		lbs	%	Tons	%	%	%	%	%	Number
3755LH67	2747aa x 0755-S1(LIYR)	12,792	3.4	34.58	2.5	18.52	0.4	0.0	0.6	124
3755KH67	2747aa x 0755-S1(SY)	12,637	1.9	35.49	5.7	17.84	-3.3	0.5	0.2	128
3755JH67	2747aa x 0755-S1(CO)	12,431	0.0	33.85	0.0	18.44	0.0	0.4	0.2	125
3755MH67	2747aa x 0755-S1(LIYS)	12,032	-3.8	31.54	-8.0	19.19	4.1	0.0	0.2	121
3755L	0755-S1(LIYR)aa x A	11,347	7.3	31.32	8.4	18.11	-1.3	1.9	0.3	131
3755K	0755-S1(SY)aa x A	11,001	4.0	28.98	0.3	19.01	3.7	0.6	0.2	125
3755J	0755-S1(CO)aa x A	10,580	0.0	28.89	0.0	18.34	0.0	1.4	0.0	131
3755M	0755-S1(LIYS)aa x A	10,093	-4.6	27.57	-4.6	18.32	-0.1	1.1	0.2	133
Mean		11,614		31.53		18.47		0.7	0.2	127
LSD (.05)		634	5.5	2.30	7.3	0.87	4.7	0.9	0.0	NS
C. V. (%)		5.4		7.3		4.7		123.6	275.4	7.9
F value for varieties		20.4**		13.0**		2.1NS		4.5**	0.7NS	1.4NS
F value for popns vs. hybrids		47.3**		26.6**		0.1NS		24.4**	1.0NS	1.8NS
F value for variety x trtmts		0.7NS		2.0NS		4.3**		2.6NS	0.2NS	2.2NS

[1/] SY = sugar yield. LIYR and LIYS = divergent selections for SY under LIY conditions. CO = unselected check synthetic from recombined S_1 families. 2747 = S^f, MM, A:aa population similar to C37. 0755 = S^f, mm, A:aa populations. In 1981, 84 S_1 families from 9755 were topcrossed to C37 and evaluated in incomplete block trials at Brawley and Salinas. At Salinas three reps were grown and at Brawley, results were based upon a single rep. In both locations, seven S_1-TX entries plus one check were maintained as sets and selection was based upon the best line(s) within each set. In the Imperial Valley, severe LIY occurred in the 1982 evaluation trial. Based upon the SY performance of the S_1-TX hybrids, S_1 families were selected and recombined. 3755J is the CO or unselected check produced by recombining all 84 S_1 families. 3755K is a C1 synthetic based upon a 20% selection for SY. 3755L and 3755M are divergent selections for SY based upon the single replication at Brawley under severe LIY. The variety hybrids 3755KH67, etc. were produced at the time the S_1 families were being recombined. In test 1784, individual S_1-TX (0755-#'s) hybrids were re-evaluated.

USDA: TEST 884-2. PERFORMANCE AND CA OF CO:C1 SYNTHETICS OF 755 POPULATIONS, SALINAS, CALIFORNIA, 1984

4 popn x 2 trmts x 8 reps., split-plot
1-row plots, 30 ft. long

Planted: April 12, 1984
Harvested: October 29, 1984

Variety	Description[1/]	Acre Yield: Sugar Actual (Lbs)	Acre Yield: Sugar Change (%)	Acre Yield: Beets Actual (Tons)	Acre Yield: Beets Change (%)	Sucrose Actual (%)	Sucrose Change (%)	Root Rot (%)	Beets/100' (Number)
3755KH67	2747aa x 0755-S1(SY)	8,886	2.0	30.50	1.2	14.55	0.5	0.0	128
3755JH67	2747aa x 0755-S1(CO)	8,751	0.0	30.21	0.0	14.48	0.0	0.0	119
3755MH67	2747aa x 0755-S1(LIYS)	8,599	-2.2	28.37	-7.6	15.13	4.5	1.0	122
3755LH67	2747aa x 0755-S1(LIYR)	8,503	-3.6	29.41	-3.3	14.44	-0.3	0.0	124
3755L	0755-S1(LIYR)aa x A	7,510	9.3	26.24	8.9	14.29	0.2	0.0	124
3755K	0755-S1(SY)aa x A	7,303	6.3	25.90	7.5	14.11	-1.1	0.4	120
3755J	0755-S1(CO)aa x A	6,869	0.0	24.10	0.0	14.26	0.0	0.0	113
3755M	0755-S1(LIYS)aa x A	6,561	-4.5	22.69	-8.5	14.44	1.3	0.0	112
Mean		7,873		27.18		14.46		0.17	120
LSD (.05)		690	8.8	1.98	7.3	0.59	4.1	0.00	10
C. V. (%)		8.7		7.2		4.0		471.9	8
F value for varieties		14.3**		17.4**		2.1NS		1.6NS	2.2NS
F value for popns vs hybrids		30.4**		32.5**		5.3NS		0.5NS	8.3*
F value for varieties x trtmts		2.7NS		2.7NS		0.7NS		2.2NS	0.6NS

[1/] See footnote 1 for 884-1.

TEST 984-1. PERFORMANCE AND CA OF CO:C1 SYNTHETICS C, D, E, F & G OF POPN 755, SALINAS, CA, 1984

8 popn x 2 trmts x 8 reps., split-plot
2-row plots, 30 ft. long

Planted: January 17, 1984
Harvested: September 10-11, 1984

Variety	Description[1/]	Acre Yield: Sugar Actual	Acre Yield: Sugar Change	Acre Yield: Beets Actual	Acre Yield: Beets Change	Sucrose Actual	Sucrose Change	Bolting	Root Rot	Beets/ 100'
		lbs		Tons		%		%	%	Number
E337H60	2755Gaa x C37	15,559	2.7	44.33	2.1	17.55	0.5	0.3	0.2	130
E337H56	2755Caa x C37	15,234	0.0	43.62	0.0	17.47	0.0	0.4	1.1	129
E337H57	2755Daa x C37	15,039	-1.6	42.60	-3.0	17.70	1.3	0.2	1.0	128
E337H54	2757aa x C37	15,012	-1.8	43.34	-0.8	17.41	-0.3	0.0	0.7	127
E337H55	2755aa x C37	14,934	-2.5	41.93	-5.0	17.88	2.3	0.2	0.5	127
E337H53	8755aa x C37	14,844	-3.2	42.18	-4.2	17.68	1.2	0.2	0.3	132
E337H59	2755Faa x C37	14,739	-4.0	42.53	-3.2	17.38	-0.5	0.4	0.3	127
E337H58	2755Eaa x C37	14,324	-7.4	39.93	-10.8	17.96	2.7	0.0	1.0	128
2755D	9755-S_1(SY)aa x A	12,900	5.3	36.41	6.6	17.77	-1.4	1.9	0.7	120
2757	1757aa x A	12,829	4.7	36.25	6.1	17.71	-1.7	5.2	0.3	121
2755	1755aa x A	12,689	3.5	35.72	4.6	17.82	-1.1	6.3	0.3	128
2755F	9755-S_1(LSY)aa x A	12,529	2.2	35.44	3.8	17.71	-1.7	4.0	1.1	127
2755G	9755-S_1(L%S)aa x A	12,366	0.9	36.06	5.6	17.24	-4.3	2.7	0.5	121
2755C	9755-S_1(CHECK)aa x A	12,256	0.0	34.16	0.0	18.02	0.0	2.3	0.5	125
8755	7755Baa x A	11,912	-2.8	34.13	-0.1	17.54	-2.6	0.8	1.0	115
2755E	9755-S_1(%S)aa x A	11,908	-2.8	32.66	-4.4	18.26	1.3	1.2	1.7	122
Mean		13,692		38.83		17.69		1.6	0.7	125
LSD (.05)		903	6.6	3.40	8.8	0.74	4.2	1.5	NS	9.5
C. V. (%)		6.7		8.8		4.2		90.7	183.9	7.6
F value for varieties		17.8**		11.2**		1.0NS		14.6**	0.8NS	1.7NS
F value for popns vs. hybrids		126.9**		80.0**		1.1NS		80.8**	0.6NS	2.0NS
F value for varieties x trtmts		0.9NS		0.4NS		0.6NS		7.3**	0.7NS	2.2*

[1/] See footnote for Test 984-1 on Test 1084-1 (next page).

TEST 2884. GCA TEST OF S_3 LINES PRODUCED BY SINGLE-SEED DESCENT, SALINAS, CA, 1984

16 entries x 8 reps., RCB
1-row plots, 30 ft. long

Planted: April 12, 1984
Harvested: October 30, 1984

Variety[1]	Description[2]			Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract Sugar
	CMS	T-O	♂	Sugar lbs	Beets Tons	%	%	Number	%	%	Lbs/T
Checks											
Y246H8	C562	C546	C46	7,915	26.22	15.11	0.4	104	3.33	81.9	247
Y246H26	C779		C46	8,805	28.72	15.34	0.6	121	3.08	83.3	255
Y246H47	Popn-790		C46	8,736	28.96	15.04	0.0	114	3.18	82.4	248
Y246H49	C779	Popn-790	C46	8,919	28.64	15.57	0.3	120	3.04	83.6	260
High Sugar Yield											
Y246H50-69	C779	790-69	C46	9,701	30.80	15.73	0.0	114	3.21	83.0	261
Y246H50-25	C779	790-25	C46	9,672	31.29	15.49	0.4	126	3.26	82.6	256
Y246H50-16	C779	790-16	C46	9,650	31.16	15.48	0.0	125	3.27	82.5	255
Y246H50-81	C779	790-81	C46	9,605	31.90	15.06	0.4	126	2.93	83.7	252
Y246H50-94	C779	790-94	C46	9,469	30.71	15.39	0.4	120	3.18	82.8	255
Y246H50-33	C779	790-33	C46	9,074	29.55	15.36	0.3	116	3.24	82.5	253
Y246H50-46	C779	790-46	C46	8,834	29.10	15.21	0.4	114	3.01	83.4	254
Y246H50-88	C779	790-88	C46	8,640	29.10	14.85	1.6	112	3.29	81.8	243
Low Sugar Yield											
Y246H50-34	C779	790-34	C46	8,908	28.31	15.68	0.0	108	3.16	83.2	261
Y246H50-97	C779	790-97	C46	8,358	26.91	15.48	0.0	107	3.18	82.9	256
Y246H50-62	C779	790-62	C46	8,245	27.55	14.97	0.7	120	3.24	82.1	246
Y246H50-21	C779	790-21	C46	8,201	26.13	15.68	0.0	108	3.31	82.5	258
Mean				8,921	29.06	15.34	0.3	116	3.18	82.8	254
LSD (.05)				696	2.02	0.50	NS	12	NS	NS	10
C. V. (%)				7.9	7.0	3.3	294.1	10.5	8.1	1.5	4
F value				5.3**	6.1**	2.4**	1.2NS	2.7**	1.6NS	1.7NS	2.2**

Note: See test 2084 and pages A14-16, 1983 Report.

1/ In 1983, 64 entries were tested for performance. On the basis of test 1083, 12 hybrids were selected for retest. Categorized by their 1983 performance, 8 high sugar yield and 4 low sugar yield hybrids were retested.

2/ See test 2084.

TEST 2084. GCA TEST OF S_3 LINES PRODUCED BY SINGLE-SEED DESCENT, SALINAS, CA, 1984

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: October 2-3, 1984

Variety[1]	Description[2]			Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract Sugar
	CMS	T-O	♂	Sugar lbs	Beets Tons	%	%	Number	%	%	Lbs/T
Checks											
Y246H8	C562	C546	C46	10,625	30.15	17.70	0.6	109	2.96	85.7	303
Y246H26	C779			10,494	29.56	17.81	0.7	124	2.73	86.7	308
Y246H47	popn-790		C46	11,421	31.54	18.15	0.6	124	2.77	86.8	314
Y246H49	C779	popn-790	C46	11,717	32.74	17.94	0.0	123	2.81	86.5	310
Y246H49	C779	popn-790	C46	11,420	32.20	17.77	0.3	127	3.00	85.6	304
High Sugar Yield											
Y246H50-92	C779	790-92	C46	12,444	35.20	17.76	0.3	121	2.81	86.4	306
Y246H50-12	C779	790-12	C46	11,704	32.36	18.09	0.3	126	2.85	86.4	312
Y246H50-106	C779	790-106	C46	11,629	32.72	17.79	0.7	121	2.75	86.6	308
Y246H50-33	C779	790-33	C46	11,628	32.63	17.88	0.0	126	2.86	86.2	308
Y246H50-84	C779	790-84	C46	11,613	33.38	17.45	1.0	121	2.82	86.1	300
Y246H50-25	C779	790-25	C46	11,610	32.15	18.08	0.4	124	2.99	85.8	310
Y246H50-46	C779	790-46	C46	11,530	31.97	18.07	1.4	122	2.74	86.9	313
Y246H50-88	C779	790-88	C46	11,508	32.16	17.91	1.2	116	2.95	85.9	307
Y246H50-81	C779	790-81	C46	11,507	32.14	17.94	0.3	121	2.56	87.5	313
Y246H50-94	C779	790-94	C46	11,424	32.25	17.76	0.4	119	2.98	85.6	304
Y246H50-85	C779	790-85	C46	11,403	31.27	18.24	0.8	119	3.00	85.9	313
Y246H50-16	C779	790-16	C46	10,906	30.87	17.72	0.4	118	2.86	86.1	305
Low Sugar Yield											
Y246H50-62	C779	790-62	C46	11,287	31.93	17.73	0.0	122	2.77	86.5	306
Y246H50-97	C779	790-97	C46	11,105	31.11	17.86	0.8	112	2.87	86.2	307
Y246H50-21	C779	790-21	C46	10,651	30.30	17.63	0.0	108	2.96	85.6	301
Y246H50-34	C779	790-34	C46	10,588	29.16	18.20	0.4	116	2.85	86.5	314

TEST 2084. GCA TEST OF S_3 LINES PRODUCED BY SINGLE-SEED DESCENT, SALINAS, CA, 1984 (Continued)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: March 8, 1984
Harvested: October 2-3, 1984

Variety	Description			Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract Sugar
	CMS	T-O	o	Sugar lbs	Beets Tons	%	%	Number	%	%	Lbs/T
High % Sucrose											
Y246H50-69	C779	790-69	C46	11,942	32.61	18.36	0.7	120	2.93	86.3	316
Y246H50-5	C779	790-5	C46	11,716	32.25	18.23	0.4	117	2.80	86.7	316
Y246H50-75	C779	790-75	C46	11,611	31.21	18.58	0.4	114	2.83	86.8	322
Y246H50-57	C779	790-57	C46	11,133	30.87	18.04	1.5	119	3.00	85.7	309
Y246H50-102	C779	790-102	C46	11,037	31.10	17.76	0.0	111	2.79	86.4	306
Y246H50-47	C779	790-47	C46	11,021	30.07	18.36	0.8	118	3.11	85.6	3[illegible]
Y246H50-6	C779	790-6	C46	11,016	30.60	18.05	1.0	123	3.02	85.7	309
Low % Sucrose											
Y246H50-41	C779	790-41	C46	11,686	32.99	17.76	0.3	119	2.81	86.4	306
Y246H50-7	C779	790-7	C46	11,394	31.64	18.02	0.3	121	2.83	86.4	311
Y246H50-64	C779	790-64	C46	11,391	32.16	17.74	0.0	126	2.79	86.4	306
Y246H50-89	C779	790-89	C46	11,272	32.43	17.44	0.8	119	2.74	86.5	301
Mean				11,357	31.74	17.93	0.5	120	2.86	86.3	309
LSD (.05)				879	NS	NS	NS	11	NS	1.0	11
C. V. (%)				7.9	9.8	3.7	239.6	9	9.7	1.2	3.7
F value				1.8**	1.2NS	1.2NS	0.8NS	1.6*	1.3NS	1.7**	1.5**

Note: See pages A14-16, 1983 Report (GCA of randomly derived inbred lines).

1/ In 1983, 64 entries were tested for performance. On the basis of test 1083, 27 hybrids were selected for retest. These hybrids were categorized by their 1983 performance into: High sugar yield, low sugar yield, high % sucrose, and low % sucrose.

2/ For hybrids Y246H50-No., the S_3 type-0 component was derived by SSD from popn-790(C1). A common CMS inbred, C779CMS, was used. The resulting F_1CMS females were topcrossed to C46. Thus, except for the change of the type-0 component, these hybrids should be equivalents and any significant change in their performance should be attributable to differences in the GCA of the S_3 inbred. The single-cross 779CMS x C46 and population hybrid 790HO x C46 were used as checks.

TEST 784-1. S_1 PROGENY RECURRENT SELECTION:
PERFORMANCE AND CA OF CO:C1:C2 SYNTHETICS OF POPN-790, SALINAS, CA, 1984

4 popn x 2 trmts x 8 reps., split-plot[1/]
2-row plots, 30 ft. long

Planted: January 17, 1984
Harvested: September 13-14, 1984

Variety[2/]	Description[3/]	Acre Yield[4/] Sugar Actual lbs	Sugar Change %	Beets Actual Tons	Beets Change %	Sucrose Actual %	Sucrose Change %	Bolting %	Root Rot %	Beets/ 100' Number
Y246H67	7790Daa x C46 C1	11,551	9.7	31.63	10.1	18.31	-0.7	0.0	0.3	130
Y246H69	1790aa x C46 C2(S_1 + BP)	11,252	6.4	30.01	3.7	18.78	2.0	0.2	0.2	127
Y246H68	1790Daa x C46 C2	11,090	4.6	29.70	2.5	18.69	1.5	0.0	0.0	134
Y246H66	7790Caa x C46 C0	10,679	0.0	29.06	0.0	18.43	0.0	0.0	0.7	133
2790	1790aa x A C2(S_1 + BP)	10,214	13.3	27.36	7.0	18.68	5.4	0.2	0.0	138
1790D	9790-S_1(SY)aa x A C2	10,125	12.3	26.93	5.3	18.82	6.2	0.2	0.8	138
7790D	5790-SY(S_1)aa x A C1	9,792	8.6	27.14	6.2	18.04	1.8	1.1	1.1	129
7790C	5790-C0(S_1)aa x A C0	9,015	0.0	25.56	0.0	17.72	0.0	1.0	0.9	124
Mean		10,465		28.42		18.43		0.3	0.5	132
LSD (.05)		608	5.8	2.15	7.6	NS	4.2	0.6	NS	NS
C. V. (%)		5.8		7.5		4.1		195.4	174.8	8.0
F value for varieties		15.5**		7.0**		2.1NS		4.2**	2.0NS	1.7NS
F value for popns. vs hybrids		60.3**		34.2**		0.8NS		11.1*	1.9NS	0.1NS
F value for varieties x trtmts		2.0NS		0.7NS		1.0NS		3.3*	1.5NS	7.1**

1/, 2/, 3/, 4/ See footnotes for test 784-2.

Note: See tests 183-1 and 183-2, pages A13, A32-33, 1983 report.

TEST 784-2. S_1 PROGENY RECURRENT SELECTION:
PERFORMANCE AND CA OF CO:C1:C2 SYNTHETICS OF POPN-790, SALINAS, CA, 1984

4 popn x 2 trmts x 8 reps., split-plot[1]
1-row plots, 30 ft. long

Planted: April 12, 1984
Harvested: October 29, 1984

Variety[2]	Description[3]	Acre Yield[4] Sugar Actual	Sugar Change	Beets Actual	Beets Change	Sucrose Actual	Sucrose Change	Root Rot	Beets/ 100'
		lbs	%	Tons	%	%	%	%	Number
Y246H69	1790aa x C46 C2(S_1 + BP)	8,606	10.8	28.51	8.1	15.11	1.5	0.0	114
Y246H68	1790Daa x C46 C2	8,471	8.5	28.65	8.7	14.78	-0.9	0.0	117
Y246H67	7790Daa x C46 C1	8,399	7.3	28.82	9.5	14.60	-2.3	0.0	116
Y246H66	7790Caa x C46 C0	7,956	0.0	26.69	0.0	14.91	0.0	0.0	114
1790D	9790-S_1(SY)aa x A C2	7,750	28.1	27.30	21.9	14.23	5.2	0.9	128
2790	1790aa x A C2(S_1 + BP)	7,272	20.2	25.18	12.4	14.42	6.6	0.0	117
7790D	5790-SY(S_1)aa x A C1	7,013	15.9	25.47	13.7	13.77	1.8	0.8	111
7790C	5790-C0(S_1)aa x A C0	6,050	0.0	22.40	0.0	13.53	0.0	0.8	99
Mean		7,690		26.63		14.42		0.3	114
LSD (.05)		624	8.1	2.02	7.6	0.66	4.6	NS	10.4
C. V. (%)		8.1		7.6		4.5		273.6	9.0
F value for varieties		15.8**		9.6**		5.7**		2.1NS	4.8**
F value for popns vs hybrids		36.9**		25.9**		12.4**		8.4*	0.2NS
F value for varieties x trtmts		2.9*		1.6NS		1.5NS		1.0NS	5.3**

[1] Main plots are synthetics vs. their corresponding hybrids. Subplots are C0, C1, C2, and C2(S_1 + BP).

[2] Corresponding synthetics and hybrids are denoted by C0, C1, C2, and C2(BP).

[3] S_1 progenies were initially derived from monogerm, self-fertile, A:aa popn-5790. Following progeny tests and a 20% selection intensity for gross sugar yield, the selected families were recombined through the male-sterile segregates to form the synthetic. C46 was topcrossed onto the male-sterile segregates of the synthetics to produce the hybrids. Synthetic C2(S_1 + BP) involved one cycle of S_1 selection and one of bulk-population selection.

[4] Synthetic C0(7790C) and C0 x C46(Y246H66) were used to calculate % change.

VARIETY TRIALS, BRAWLEY, CALIFORNIA, 1983-84

Location: USDA-ARS, Imperial Valley Conservation Research Center

Soil type: Holtville silty clay loam

Previous crops: 1980-81 sugarbeet; 1981-82 and 1982-83 cereals.

Fertilization: Preplant 200 lbs/A 46:0:0 and 180 lbs/A 11:48:0.

Summary: 1983-84 Tests, Brawley, California

Test No.	Date Seeded 1983[1]	Entries per Test	No. Reps.	Rows per Plot[2]	Plot Length Ft.	1984 Harvest Date	Test Design
B184	9/7	8	8	2	24	5/15	split-plot
B284	9/7	8	8	2	"	5/16	RCB
B384	9/7	16	8	2	"	5/17	RCB
B484	9/8	16	8	2	"	5/18	RCB
B584	9/8	8	8	1	"	5/18	RCB
B684	9/8	32	8	1	"	5/21-22	RCB
Obs.	9/8	48	2	1	"	-	-

[1] Watered by sprinkler 9/9-12/83 and for stand establishment.
[2] Rows 32" wide.

Irrigations: Sprinkled to establish stands, then furrow on 10/19, 11/17, 1/11, 2/13, 3/7, 3/28, and 4/18.

Thinning date: Approx. Sept. 28-30, 1983.

Herbicide: Chem-Hoe thru irrig. water (4 lbs/A) on 11/17/83.

Diseases and insects: Methomyl on 10/1, 9/28, and 9/16 at 0.72, 0.66, and 0.66 lbs/A. Sulfur (40 lbs/A) by airplane for powdery mildew control on 1/26/84 and 2/8/84. Very little bolting. Essentially no rot. PM very mild at harvest. Empoasca causing yellowing at harvest. Very high aphid population in late March - early April. All plants yellow but ELISA showed only about 30% infection with either BWYV or LIY at harvest.

Remarks: Tests should have high reliability. Plant populations were very high and few gaps occurred. No missing plot analyses were needed. Two samples per plot were run. In late March the plants in these trials were quite yellow suggesting a low nitrogen status and/or infection with yellows. However, serological tests indicated that less than 30% of the plants were infected with LIY or BWYV. Subsequently, tops greened up and by mid-April most canopies had increased in size. At harvest, yellowing was again prevalent partially due to the feeding of Empoasca. The observed conditions in these trials were fairly typical of fields observed in Imperial Valley.

Under the hot conditions that prevailed in May, shallow rooted entries and some high sugar entries seemed to "cut-out", whereas deep rooted entries maintained a larger canopy and appeared to continue to grow. At harvest, the trials were off water for 4 weeks.

We wish to acknowledge C. Brown and D. Frey for plot supervision and cultural practices. Plots were dug with Holly's harvester and sugar and tare analyses were made by Holly's tare lab.

TEST B184. PERFORMANCE AND CA OF CO:C1 SYNTHETICS OF 755 POPULATIONS, BRAWLEY, CALIFORNIA 1983-84

8 entries x 8 reps., split-plot
2-row plots, 24 ft. long

Planted: September 7, 1983
Harvested: May 15, 1984

Variety	Description[1/]	Acre Yield[2/] Sugar Actual (Lbs)	Sugar Change (%)	Beets Actual (Tons)	Beets Change (%)	Sucrose Actual (%)	Sucrose Change (%)	Beets/ 100' (No.)	Clean Beets (%)	Nitrate Nitrogen Rating
3755KH67	2747aa x 0755-S1(SY)	10,546	4.3	35.69	7.0	14.82	-2.2	156	95.7	2.5
3755LH67	2747aa x 0755-S1(LIYR)	10,376	2.4	34.19	1.9	15.23	0.5	158	95.5	2.1
3755JH67	2747aa x 0755-S1(CO)	10,167	0.0	33.62	0.0	15.16	0.0	171	95.4	2.3
3755MH67	2747aa x 0755-S1(LIYS)	9,738	-4.8	32.76	-2.9	14.90	-1.7	169	95.4	2.0
3755K	0755-S1(SY)aa x A	9,541	7.5	31.98	7.5	14.95	0.0	152	96.5	2.0
3755L	0755-S1(LIYR)aa x A	9,192	3.5	31.84	7.0	14.44	-3.4	155	97.0	2.6
3755J	0755-S1(CO)aa x A	8,879	0.0	29.76	0.0	14.94	0.0	153	96.6	2.2
3755M	0755-S1(LIYS)aa x A	8,390	-5.5	28.20	-5.2	14.92	-0.1	158	96.0	1.9
Mean		9,604		32.25		14.92		159	96.0	2.2
LSD (.05)		695	7.2	1.96	6.1	NS	4.9	NS	NS	NS
C. V. (%)		7.2		6.1		4.9		10.8	0.9	45.5
F value for varieties		5.2**		9.9**		0.3NS		1.5NS	0.9NS	0.3NS
F value for popns. vs. hybrids		161.0**		38.1**		1.1NS		1.8NS	25.7**	0.1NS
F value for popns. x hybrids		0.2NS		1.0NS		1.3NS		0.9NS	0.7NS	0.6NS

1/SY = sugar yield. LIYR and LIYS = divergent selections for SY under LIY conditions. CO = unselected check synthetic from recombined S_1 families. 2747 = S^f, MM, A:aa population similar to C37. 0755 = S^f, mm, A:aa populations. In 1981, 84 S_1 families from 9755 were topcrossed to C37 and evaluated in incomplete block trials at Brawley and Salinas. At Salinas three reps were grown and at Brawley, results were based upon a single rep. In both locations, seven S_1-TX entries plus one check were maintained as sets and selection was based upon the best line(s) within each set. In the Imperial Valley, severe LIY occurred in the 1982 evaluation trial. Based upon the SY performance of the S_1-TX hybrids, S_1 families were selected and recombined. 3755J is the CO or unselected check produced by recombining all 84 S_1 families. 3755K is a C1 synthetic based upon a 20% selection for SY. 3755L and 3755M are divergent selections for SY based upon the single replication at Brawley under severe LIY. The variety hybrids 3755KH67, etc. were produced at the time the S_1 families were being recombined. In test B684, individual S_1-TX (0755-#'s) hybrids were re-evaluated.

2/See footnotes for test B384.

TEST B284. IMPERIAL VALLEY EVALUATION OF C1 SYN 1 POPULATIONS OF 755 FOR CA AFTER FIRST CYCLE OF S_1-TX RECURRENT SELECTION, BRAWLEY, CA 1983-84

8 entries x 8 reps
2-row plots, 24 ft. long

Planted: September 7, 1983
Harvested: May 15-16, 1984

Variety	Description[1/]	Acre Yield[2/] Sugar Actual	Sugar Change	Beets	Sucrose Actual	Sucrose Change	Bolting	Beets/ 100'	Clean Beets	Nitrate Nitrogen
		Lbs	%	Tons	%	%	%	No.	%	Rating
E337H57	2755Daa x C37	11,697	4.3	35.93	16.27	0.4	0.7	153	94.6	2.5
E337H60	2755Gaa x C37	11,221	0.0	35.03	16.01	-1.2	0.4	146	95.4	2.4
E337H56	2755Caa x C37	11,220	0.0	34.65	16.20	0.0	0.6	158	95.1	1.7
E337H58	2755Eaa x C37	11,049	-1.5	33.29	16.62	2.5	0.0	143	94.9	1.6
E337H59	2755Faa x C37	10,901	-2.8	32.92	16.59	2.4	0.2	162	95.2	1.8
E337H55	2755aa x C37	10,833	-3.4	32.86	16.51	1.9	0.0	158	94.3	2.3
E337H53	8755aa x C37	10,822	-3.5	33.28	16.27	0.4	0.3	162	94.6	2.1
E337H8	F78-546H3 x C37	10,140	-9.6	31.06	16.34	0.9	0.0	157	94.2	2.0
Mean		10,985		33.63	16.35		0.3	155	94.8	2.0
LSD (.05)		520	4.7	1.75	0.36	2.2	NS	NS	0.7	NS
C. V. (%)		4.7		5.20	2.20		252.7	12	0.7	43.5
F value		6.0**		6.1**	2.7*		1.3NS	1.1NS	3.1**	1.3NS

[1/] In 1980, S_1 families from 8755 population were topcrossed to C37. Sixteen checks plus 112 S_1-TX families were evaluated in trials in 1981. On the basis of the performance of the S_1-TX progenies, S_1 families produced from remnant S_1 seed were recombined in 1982 to produce the cycle 1 (C1) synthetics. In 1983, the synthetics and source populations were topcrossed to C37 to produce variety hybrids and these were tested in 1984 to measure the response to divergent selection at 20% intensity. Population 8755 was the initial source of the S_1 progeny. 2755 represents 2 cycles of mass selection for disease resistance and sugar yield from 8755. 2755C is an unselected check produced by recombining all S_1 progenies from 8755. 2755D and 2755F are divergent selections based on sugar yield. 2755E and 2755G are divergent selections based upon % sucrose. Lines C301 through C308 and females identified as 9755-#'s retested in test B684 are increases of individual S_1 lines identified in the 1981 S_1-TX progeny tests.

[2/] See footnotes and note for test B384.

TEST B384. IMPERIAL VALLEY HYBRID TEST, BRAWLEY, CALIFORNIA, 1983-84

16 entries x 8 reps, RCB
2-row plots, 24 ft. long

Planted: September 7, 1983
Harvested: May 16-17, 1984

Variety	Description[2]			Acre Yield[1]		Sucrose	Bolting	Root Rot	Beets/ 100'	Clean Beets	Nitrate Nitrogen
	MS	T-O	Pollinator	Sugar Lbs	Beets Tons	%	%	%	No.	%	Ratings[3]
E337H50	C303aa		C37	12,297	36.88	16.68	0.0	0.0	148	95.6	2.4
E337H47	C306aa		C37	11,778	34.81	16.92	0.2	0.2	161	94.0	2.6
Y346H37	C306cms		C46	11,428	34.11	16.78	0.0	0.2	155	95.5	2.4
Y346H31	C301cms		C46	11,248	33.67	16.71	0.2	0.0	162	95.2	2.1
Y354H31	C301cms		Y254	11,117	33.47	16.62	0.3	0.0	160	95.6	2.4
Y346H64	1216aa		C46	10,709	32.08	16.72	0.0	0.0	148	94.7	2.1
E337H22	C301cms	C546	C37	10,637	31.78	16.78	0.3	0.0	161	94.5	2.2
E337H31	C301cms		C37	10,547	32.05	16.48	0.0	0.0	148	94.3	2.3
3902H31	C301cms		2902	10,385	32.43	16.02	1.5	0.0	152	95.6	2.0
HH37	Lot 82C93-02			10,287	31.03	16.61	0.2	0.0	171	95.8	1.9
E337H21	C718cms	C301	C37	10,277	30.45	16.88	0.0	0.0	144	93.9	2.2
E337H23	C718cms	C546	C37	10,106	30.09	16.86	0.0	0.0	151	93.8	2.2
3747H31	C301cms		2747	10,103	31.46	16.06	0.0	0.2	149	95.1	2.3
Y346H8	C562cms	C546	C46	10,033	29.47	17.06	0.0	0.0	169	94.9	2.8
E337H8	C562cms	C546	C37	9,664	29.38	16.49	0.0	0.0	150	94.2	2.8
US H11	C562cms	C546	C36	9,513	28.66	16.61	0.2	0.0	163	94.2	2.4
Mean				10,633	31.99	16.64	0.2	0.03	156	94.8	2.3
LSD (.05)				597	1.72	0.49	0.4	NS	15	0.9	NS
C. V. (%)				5.7	5.4	3.0	239.6	667.4	9.8	1.0	32.6
F value				12.9**	13.0**	2.6**	6.3**	0.9NS	2.3**	4.4**	0.9NS

1/ Yields adjusted to clean weight basis.

2/ 1216 = S^f, mm, A:aa line derived from population 755 x C546. Y254 = YR, MM, O.P. composite. 2902 and 2747 = S^f, MM, A:aa populations.

3/ Brei NO_3-N by Orion probe. Ratings 1, 2,---, 9 correspond to NO_3-N values of 0 to >250 ppm and to diphenylamine spot test ratings of 1 through 5.

Note: Approximately 30% of the plants were infected with BWYV and/or LIY.

TEST B484. IMPERIAL VALLEY ADVANCED HYBRID TEST, BRAWLEY, CALIFORNIA, 1983-84

16 entries x 8 reps
2-row plots, 24 ft. long

Planted: September 8, 1983
Harvested: May 17-18, 1984

Variety	Description[2]			Acre Yield[1]		Sucrose	Bolting	Root Rot	Beets/ 100'	Clean Beets	Nitrate Nitrogen
	MS	T-O	Pollinator	Sugar Lbs	Beets Tons	%	%	%	No.	%	Rating
Y346H55	2755aa		C46	11,602	34.40	16.91	0.0	0.0	165	95.1	2.3
Y346H31	C301cms		C46	11,498	33.97	16.95	0.0	0.0	161	94.8	2.6
Y346H72	C718cms		C46	10,999	33.06	16.71	0.0	0.0	169	94.7	2.3
1463-02	Holly			10,894	32.19	16.93	1.5	0.0	163	95.5	2.4
1455-02	Holly			10,786	32.20	16.78	0.0	0.0	165	96.0	2.6
E337H31	C301cms		C37	10,752	32.44	16.58	0.0	0.0	152	93.9	2.3
HH37	Lot 82C93-02			10,708	32.16	16.68	0.8	0.0	163	95.7	2.6
Y346H8	C562cms	C546	C46	10,638	30.79	17.34	0.0	0.0	173	94.3	2.2
USC-1	Union			10,413	29.95	17.41	0.0	0.0	172	94.6	2.4
3902H55	2755aa		2902	10,385	31.11	16.73	0.4	0.1	166	93.8	2.4
3747H55	2755aa		2747	10,300	31.24	16.51	0.5	0.0	158	94.3	2.4
Y339H8	C562cms	C546	Y139	10,233	29.84	17.16	0.0	0.0	154	95.6	2.4
US H11	C562cms	C546	C36	10,214	30.69	16.67	0.2	0.0	164	93.3	2.5
E337H8	C562cms	C546	C37	10,168	30.47	16.72	0.0	0.0	149	94.1	2.3
SS-Z1	Spreckels			9,935	29.46	16.90	0.3	0.0	178	95.2	2.5
H79254	Spreckels			9,633	28.83	16.76	0.0	0.0	172	95.8	2.8
Mean				10,572	31.42	16.86	0.2	0.0	164	94.8	2.4
LSD (.05)				551	1.44	0.47	0.5	NS	15	0.9	NS
C. V. (%)				5.3	4.6	2.8	214.5	1131.4	9.2	0.9	24.8
F value				7.1**	9.6**	2.3**	5.5**	1.0NS	2.3**	6.7**	0.6NS

[1] See note and footnotes for B384.

[2] 2747 and 2902 = S^f, MM, A:aa popns. Y139 = YR, MM, O.P. line. 2755 = S^f, mm, A:aa popn.

TEST B684. IMPERIAL VALLEY RETEST OF 755 PROGENIES, BRAWLEY, CALIFORNIA, 1983-84

32 entries x 8 reps
1-row plots, 24 ft. long

Planted: September 8, 1983
Harvested: May 21-22, 1984

Variety	Description[1]		Acre Yield[2]		Sucrose	Bolting	Beets/ 100'	Clean Beets	Nitrate Nitrogen	Canopy Score[3]
	MS	Pollinator	Sugar Lbs	Beets Tons	%	%	No.	%	Rating	
US H11	C546H3	C36	10,053	29.49	17.05	0.0	177	95.0	2.9	1.8
E337H8	C546H3	C37	9,828	28.66	17.18	0.0	157	95.3	2.7	2.0
E337H4	C563cms	C37	9,699	28.35	17.20	0.0	150	95.8	3.0	2.0
E337H72	C718cms	C37	10,476	30.92	16.97	0.0	148	94.4	3.1	2.8
E337H55	2755aa	C37	10,962	31.45	17.44	0.0	164	94.9	3.1	3.0
E337H42	2802aa	C37	11,798	34.05	17.36	0.0	167	94.8	2.9	3.1
E337H43	2803aa	C37	11,356	32.95	17.26	0.0	160	95.8	2.8	2.9
E337H44	2804aa	C37	11,258	32.41	17.38	0.0	147	95.3	3.0	2.3
E337H50	C303aa	C37	13,338	38.27	17.43	0.0	152	95.9	2.9	3.5
E337H47	C306aa	C37	11,655	33.81	17.26	0.0	154	94.9	2.7	3.0
E337H49	C302aa	C37	11,615	34.29	16.97	0.3	171	95.1	2.8	3.0
E337H31	C301cms	C37	10,951	32.19	17.04	0.0	141	95.4	2.9	2.3

1/ C546H3 = C562cms x C546. 2755 = S^f, mm, A:aa population. 2802 = C1 Syn 1 of 755 by S_1-TX selection. 2803= T-O sel. 755. 2804 = 2 T-O sel. 755. C308 = Inc. 9755-43. 1757-#'s = S_1's from T-O sel. 755. C301-C307 and 9755-#'s were originally tested as S_1-TX hybrids in 1981. 0755-#'s were tested as S_1-TX hybrids in 1982. 1757-#'s were tested as S_1-TX hybrids in 1983. Also see tests B183 (page A37), 1583 (pages A30-31) and elsewhere in 1983 Report; Tests 1982 (pages A34-35) and elsewhere in 1982 Report.

2/ See footnotes for test B384.

3/ Canopy size and integrity under the conditions of this test were highly variable. Under I. V. conditions, it may be desirable for hybrids to maintain a vigorous canopy. Canopy at harvest was scored 1 = very small to 5 = large and uniform.

TEST B684. IMPERIAL VALLEY RETEST OF 755 PROGENIES, BRAWLEY, CALIFORNIA, 1983-84 (Cont'd.)

32 entries x 8 reps
1-row plots, 24 ft. long

Planted: September 8, 1983
Harvested: May 21-22, 1984

Variety	Description		Acre Yield		Sucrose	Bolting	Beets/ 100'	Clean Beets	Nitrate Nitrogen	Canopy Score
	MS	Pollinator	Sugar Lbs	Beets Tons	%	%	No.	%	Rating	
E337H48	C307aa	C37	10,938	32.24	17.02	0.3	148	94.6	2.6	2.9
E337H46	C305aa	C37	10,661	30.88	17.26	0.7	152	95.1	2.9	3.1
E337H45	C304aa	C37	9,717	27.84	17.48	0.0	158	95.7	3.0	2.0
E037HL16-18	9755-18aa	C37	11,480	33.05	17.41	3.3	156	94.6	2.8	3.3
E037HL16-112	9755-112aa	C37	11,443	32.47	17.66	0.4	177	95.4	2.6	2.5
E037HL16-77	9755-77aa	C37	11,179	31.83	17.61	0.4	174	95.2	2.8	2.5
E037HL16-10	9755-10aa	C37	10,561	30.65	17.29	0.0	163	94.3	3.1	2.8
E037HL16-43	9755-43aa	C37	10,474	29.63	17.72	0.8	145	94.5	2.6	2.8
E037HL16-133	9755-133aa	C37	9,945	28.21	17.63	0.3	172	94.8	2.9	1.5
E137HL45-30	0755-30aa	C37	12,733	38.00	16.78	0.0	146	95.1	3.1	4.1
E137HL45-51	0755-51aa	C37	11,880	33.38	17.81	0.0	159	93.3	2.4	2.6
E137HL45-53	0755-53aa	C37	11,835	34.64	17.12	0.3	158	94.8	2.8	3.3
E137HL45-70	0755-70aa	C37	11,559	32.51	17.81	0.0	148	94.9	2.9	2.4
E137HL45-16	0755-16aa	C37	11,438	33.55	17.06	0.0	165	93.6	2.8	3.1
E137HL45-87	0755-87aa	C37	10,467	30.40	17.27	0.0	143	93.9	2.7	3.3
E137HL45-46	0755-46aa	C37	9,397	26.32	17.87	0.0	168	93.8	2.8	2.6
E137HL45-22	0755-22aa	C37	9,224	25.93	17.84	0.0	144	93.6	2.8	1.0
Y246H57-28	1757-28aa	C46	11,784	34.31	17.18	0.7	170	97.2	2.6	2.9
Y246H57-7	1757-7aa	C46	11,705	33.15	17.69	0.0	155	96.5	2.6	2.1
Y246H57-10	1757-10aa	C46	11,318	32.50	17.43	0.0	161	96.6	3.0	3.1
Mean			11,023	31.82	17.36	0.2	158	95.0	2.8	2.7
LSD (.05)			699	2.18	0.51	0.9	20	0.9	NS	0.7
C. V. (%)			6.4	7.0	3.0	385.9	13	1.0	19.80	25.1
F value			14.0**	13.3**	2.5**	3.8**	2.1**	7.0**	0.8NS	7.1**

TEST B584. IMPERIAL VALLEY POWDERY MILDEW RESISTANT HYBRID TEST, BRAWLEY, CALIFORNIA, 1983-84

8 entries x 8 reps
1-row plots, 24 ft. long

Planted: September 8, 1983
Harvested: May 18, 1984

Variety	Description[2]			Acre Yield[1]		Sucrose	Bolting	Beets/ 100'	Clean Beets	Nitrate Nitrogen
	MS	T-O	Pollinator	Sugar Lbs	Beets Tons	%	%	No.	%	Rating
335-2H34	2804cms		C35/2	11,395	33.04	17.25	0.3	165	94.2	1.8
335-1/2H34	2804cms		35-1/2	11,220	32.84	17.13	0.6	171	94.6	2.1
E337H34	2804cms		C37	11,036	31.65	17.50	0.5	169	94.7	2.1
335-1H34	2804cms		C35/1	10,876	31.89	17.09	0.0	176	94.9	2.1
335-1/2H8	C562cms	C546	35-1/2	10,543	30.63	17.25	0.0	180	93.9	2.1
335-2H8	C562cms	C546	C35/2	9,824	28.27	17.40	0.0	175	94.1	2.0
US H11	C562cms	C546	C36	9,724	27.98	17.40	0.3	168	94.9	2.1
335-1H8	C562cms	C546	C35/1	9,413	26.86	17.57	0.0	160	95.3	2.1
Grand Mean				10,504	30.39	17.32	0.2	170	94.6	2.1
LSD (.05)				691	2.05	NS	NS	NS	NS	NS
C. V. (%)				6.5	6.7	2.2	370.9	10.5	1.3	22.2
F value				9.6**	10.9**	1.6NS	0.8NS	1.1NS	1.2NS	0.7NS

[1] See footnotes for test B384.

[2] 2804cms = cms counterpart of 2nd T-O selection from population 755. C35/1 and C35/2 = lines similar to C36 reselected for resistance to powdery mildew (see Crop Science 24:830. 1984.) Powdery mildew was controlled with sulfur and probably was not a significant factor in this test.

TEST 3184. EVALUATION OF CHINESE ACCESSIONS, SALINAS, CA, 1984

24 entries x 5 reps, RCB[1/]
1-row plots, 20 ft. long

Planted: May 25, 1984
Harvested: October 31, 1984

Variety	Description[2/]	Acre Yield Sugar lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number
Y346H55	2755aa x F82-46	6,597	22.14	14.90	0.0	109
PI2434	PI452434 (Tien Yen 3)	5,610	17.78	15.76	1.0	106
3107-6	PI467874 x 69-81	5,600	17.29	16.18	1.9	113
US H11	282110	5,515	20.09	13.70	0.0	117
3107-11	PI467879 x 69-81	5,436	16.02	16.92	0.9	105
3107-3	PI467871 x 69-81	5,283	16.02	16.48	0.9	122
3107H55	2755aa x PI69-81	5,188	16.68	15.54	0.0	114
3107-10	PI467878 x 69-81	5,174	16.99	15.30	1.0	99
3101	Inc. NS-358 (C1)	5,095	16.43	15.50	0.0	96
3107-12	PI467880 x 69-81	5,019	15.69	15.98	1.1	104
3107-9	PI467877 x 69-81	5,007	16.10	15.58	2.0	98
3107-1	PI467869 x 69-81	4,899	14.90	16.44	0.8	109
3107-5	PI467873 x 69-81	4,891	15.27	16.04	2.3	101
3104	Inc. NS-C4	4,545	15.72	14.46	1.8	88
3103	Inc. NS-C3	4,539	14.65	15.48	0.0	110
3107-2	PI467870 x 69-81	4,512	13.45	16.72	2.5	103
3107-8	PI467876 x 69-81	4,444	13.20	16.82	1.0	102
3105	Inc. NS-C5	4,409	14.60	15.10	0.0	97
3107-7	PI467875 x 69-81	4,386	13.57	16.16	0.0	96
3106	Inc. NS-C6	4,355	14.55	14.96	3.7	101
3107-13	PI467881 x 69-81	4,326	13.38	16.16	0.8	97
3102	Inc. NS-359 (C2)	4,312	14.15	15.22	0.0	98
3107-4	PI467872 x 69-81	4,226	13.30	15.90	1.1	85
PI2435	PI452435 (Tien Yen 4)	4,051	13.40	15.12	0.0	92
Mean		4,892	15.64	15.68	1.0	102
LSD (.05)		399	1.18	0.68	NS	13
C. V. (%)		6.5	6.0	3.50	251.8	10.2
F value		6.3**	9.7**	10.1**	0.9NS	1.6NS

1/ Test was planted with 8 reps, but because of poor stands, reps 1-3 were wound-inoculated with Erwinia and not evaluated for yield. Erwinia root rot and PM data for reps 1-3 are shown elsewhere.

2/ PI452434 and 452435 accessed about 1980 from China. NS-358,NS-359,NS-C3,NS-C4, NS-C5, NS-C6 are Chinese lines received from Novi Sad, Yugoslavia. PI467869-PI467881 accessed from China and increased individually at Salinas and Ft. Collins. In addition, these accessions were increased at Salinas as a polycross with the identity of the female retained, i.e., PI467874 x 69-81 = PI467874 line polycrossed to accessions PI467869-81. Polycross seed was evaluated in this test.

Note: This test was adjacent to the VY, ERR, and PM selection and evaluation plots. BWYV severity was high. PM was very high and not controlled. In general, compared to US H11, the Chinese accessions appeared to be moderately resistant to PM but very susceptible to VY; they had very large canopies. Under disease-free conditions, some Chinese accessions may have high sucrose content.

TEST 3184. EVALUATION OF CHINESE ACCESSIONS, SALINAS, CA, 1984

24 entries x 3 reps (ERR), 8 reps (PM)
1-row plots, 20 ft. long

Planted: May 25, 1984
Inoc.: August 10, 1984
Harvested: November 1984

Variety[3]	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
3101	Inc. NS-358	45	35.7	55.6	2.0	3.4	4.8	5.5	3.9
3102	Inc. NS-359	47	41.7	53.2	2.0	3.3	5.8	6.5	4.4
3103	Inc. NS-C3	54	16.1	74.1	2.3	3.5	5.9	6.6	4.6
3104	Inc. NS-C4	24	7.3	87.5	2.0	2.6	4.8	6.1	3.9
3105	Inc. NS-C5	48	34.2	60.4	2.0	3.5	5.5	6.6	4.4
3106	Inc. NS-C6	30	54.9	36.7	2.8	3.6	6.5	7.5	5.1
PI2434	452434 (Tien Yen 3)	50	20.0	74.0	2.3	3.5	5.3	6.0	4.3
PI2435	452435 (Tien Yen 4)	49	37.9	53.1	2.5	4.0	5.8	6.8	4.8
3107-1	PI467869 x 69-81	55	19.0	69.1	2.8	4.3	6.0	7.0	5.0
3107-2	PI467870 x 69-81	53	20.9	68.1	3.0	4.3	6.5	7.8	5.4
3107-3	PI467871 x 69-81	59	35.1	57.6	1.8	3.6	5.3	7.0	4.4
3107-4	PI467872 x 69-81	40	38.7	47.5	2.5	4.0	6.3	7.4	5.1
3107-5	PI467873 x 69-81	47	37.6	55.3	3.0	4.0	6.0	7.4	5.1
3107-6	PI467874 x 69-81	50	30.7	62.0	2.5	3.6	5.4	6.4	4.5
3107-7	PI467875 x 69-81	47	28.1	55.3	3.0	3.6	5.4	7.3	4.8
3107-8	PI467876 x 69-81	46	25.0	58.7	2.5	4.0	5.6	6.6	4.7
3107-9	PI467877 x 69-81	43	35.9	54.5	2.3	3.6	5.0	6.5	4.4
3107-10	PI467878 x 69-81	51	48.3	39.2	2.0	3.1	4.6	6.1	4.0
3107-11	PI467879 x 69-81	46	25.4	56.5	2.5	3.3	5.4	6.4	4.4
3107-12	PI467880 x 69-81	44	38.7	54.5	2.5	3.9	5.5	6.6	4.6
3107-13	PI467881 x 69-81	45	30.3	57.8	2.8	4.5	6.1	7.5	5.2
3107H55	2755aa x PI69-81	52	29.6	65.4	2.8	3.9	6.5	7.1	5.1
Y346H55	2755aa x F82-46	56	29.5	62.5	2.5	4.3	6.5	7.3	5.2
US H11	282110	45	4.6	88.9	4.3	5.4	8.0	7.9	6.4

[1,2]See footnotes for Test 2984.

[3]Entries 3101-3106 are accessions of Chinese germplasm that were obtained through Novi Sad, Yugoslavia. 3107-1 through 3107-13 are polycross increases of Chinese accessions PI467869-PI467881 in which individual PI numbers were polycrossed to the 12 other PI numbers.

POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984

R. T. Lewellen, I. O. Skoyen, and E. D. Whitney

Three tests (2984, 3084, and 3184) were grown at Salinas in 1984 to evaluate lines and hybrids to Erwinia root rot (ERR) and powdery mildew (PM).

The following footnotes apply to Tests 2984, 3084, and 3184.

1/ Erwinia root rot: Plants were inoculated on August 10, 1984, with a mixed suspension of strains MR-1, WE-1, SP-5, UR-7, SB-13. Disease ratings were made in November. DI = disease index = mean % rot/root. Individual plants were scored on a scale of 0, 1, 7, 25, 50 75, 93, and 100% rot per root. Roots with scores of 0 and 1% rot were considered resistant. E240 (C40), E340 (C40), 917 (C17), and 917H8 (US H10) were ERR susceptible checks. US H11, C36, and C546 were ERR resistant checks. Comparisons should primarily be made within sets of entries denoted by dotted lines. The disease severity in these tests was high and the ratings for ERR appear to have a high reliability. Disease intensity was much higher than that experienced for the previous 2 or 3 years.

2/ Powdery mildew: Because of late planting date, the development of PM was late. However, a high inoculum potential from susceptible border rows lead to a uniform and high level of disease. Disease ratings were made on a plot basis on a scale of 0 to 9, with 9 approximately equal to 90 to 100% of the leaf area covered by mildew. The mean ratings over four dates appeared to give the greatest differentiation between levels of resistance. The PM ratings appeared to have high reliability. The type of resistance in sugarbeet appears to be the type called "slow-mildewing" in the cereals. The greatest difference in ratings for disease severity is during the early stages of infection. Almost without exception, all lines eventually develop a high severity of disease.

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Erwinia Inoc.: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
HYBRIDS									
US H11	546H3 x C36	51	6.0	78.4	3.0	5.0	6.5	7.0	5.4
US H10	546H3 x C17	42	42.6	50.0	3.0	4.5	6.0	7.5	5.3
964H8	546H3 x 364 (C64)	47	8.7	78.7	2.0	3.0	4.0	6.5	3.9
BJ19	Bush-Johnsons	53	38.0	54.7	2.0	3.5	3.5	7.0	4.0
Monoricca	Hilleshog	50	10.5	80.0	1.0	2.5	3.5	6.0	3.3
GW149	GW(7033)	55	34.0	60.0	3.0	4.0	6.0	8.0	5.3
Ultramono	Maribo	56	23.5	71.4	2.0	3.0	4.5	7.0	4.1
HH37	Holly	54	30.9	63.0	2.0	3.0	4.0	6.5	3.9
SS-NB2	H83327	54	23.6	66.7	4.0	4.0	5.5	7.0	5.1
KW1132	Betaseed (3044-1)	47	27.4	66.0	2.0	3.0	4.5	6.5	4.0
Exp 512	Betaseed (3320-1)	52	27.8	65.4	3.0	3.0	5.0	7.0	4.5
3G5008	Betaseed	49	39.5	53.1	2.0	3.0	4.0	7.0	4.0
Monodoro	Hilleshog	56	14.0	80.4	2.0	4.0	6.5	7.5	5.0
Mono 1167	Hilleshog	48	24.6	66.7	3.0	4.5	6.0	7.0	5.1
Mono 4086	Hilleshog	51	36.9	52.9	3.0	3.5	5.0	7.0	4.6
E240	Inc. E640 (C40)	43	87.6	11.6	3.0	5.0	5.5	8.0	5.4
Y346H8	546H3 x F82-46	45	15.2	80.0	2.0	4.5	4.5	7.0	4.5
USC-1	83348	50	14.7	76.0	2.0	3.5	4.5	7.0	4.3
USC-2	83048	48	4.2	93.8	4.0	5.0	6.5	7.5	5.8
USC-3	83417	47	18.9	68.1	3.0	5.0	5.5	7.0	5.1
US H11	546H3 x C36	51	2.0	88.2	4.0	6.0	7.0	7.5	6.1
917H8	546H3 x 417 (C17)	47	38.6	53.2	3.0	6.0	6.5	8.0	5.9
Y231H8	546H3 x Y131 (C31E2)	48	20.7	60.4	2.0	3.0	5.0	7.0	4.3
Y231H19	1796H0 x Y131	41	27.8	61.0	3.0	4.0	5.0	7.0	4.8

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
HYBRIDS									
EM-1	84.1	51	46.0	41.2	3.0	3.5	3.5	7.0	4.3
EM-2	84.6	45	54.3	35.6	2.0	3.5	4.5	6.5	4.1
EM-3	84.10	51	55.5	31.4	3.0	4.0	4.5	7.0	4.6
EM-4	84.12	41	57.2	34.1	2.0	4.0	4.5	7.0	4.4
EM-5	84.15	52	41.1	38.5	2.0	5.0	5.0	6.5	4.6
Y339H8	546H3 x Y139	48	25.8	56.3	2.0	5.0	5.0	6.0	4.5
Y339H55	2755aa x Y139	49	31.2	65.3	2.0	4.5	4.0	5.5	4.0
E337H8	546H3 x F81-37	50	5.0	90.0	3.0	5.5	7.0	7.0	5.6
E337H8	546H3 x F81-37	50	14.5	76.0	4.0	5.5	7.0	7.0	5.9
E337H3	C562H0 x F81-37	46	17.5	73.9	3.0	4.5	7.0	7.5	5.5
E137HL6	C301aa x F80-37	41	15.6	73.2	5.0	5.0	7.0	7.5	6.1
E337H31	F82-301CMS x F81-37	46	21.7	67.4	4.0	4.5	7.0	7.5	5.8
F337H21	(C301 x C718) x F81-37	48	17.3	64.6	4.0	4.5	6.0	7.5	5.5
E337H22	(C301 x C546) x F81-37	48	14.3	77.1	3.0	4.5	5.5	7.0	5.0
E337H45	C304aa x F81-37	51	17.3	76.4	3.0	4.5	5.5	6.5	4.9
E337H46	C305aa x F81-37	45	21.4	66.7	4.0	4.0	6.5	7.0	5.4
E337H47	C306aa x F81-37	52	20.5	67.3	4.0	4.5	5.0	7.0	5.1
E337H48	C307aa x F81-37	48	29.3	62.5	4.0	5.0	5.5	7.5	5.5
E337H49	C302aa x F81-37	49	23.9	71.4	2.0	5.0	5.5	7.0	4.9
E337H50	C303aa x F81-37	46	16.3	77.8	3.0	5.0	4.5	7.0	4.9
E337H55	2755aa x F81-37	50	11.2	86.0	3.0	5.0	6.0	7.0	5.3
E337H72	C718H0 x F81-37	48	8.0	83.3	4.0	6.0	6.5	7.0	5.9
917H8	546H3 x 417 (C17)	43	26.0	65.1	4.0	5.5	7.0	7.5	6.0
US H11	546H3 x C36	48	2.7	85.4	5.0	6.5	7.5	8.0	6.8

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
HYBRIDS									
335-1H8	PMR from EDW	48	6.0	83.3	3.0	5.0	5.5	7.0	5.1
335-2H8	PMR from EDW	51	1.5	88.2	3.0	5.0	5.5	7.0	5.1
335-½H8	PMR from EDW	52	1.2	88.5	2.0	5.0	5.5	7.0	4.9
US H11	546H3 x C36	38	0.0	100.0	4.0	6.5	6.5	7.5	6.1
E240	Inc. E640 (C40)	44	92.1	0.0	3.0	5.0	6.0	8.0	5.5
Y354H8	546H3 x Y254	44	8.7	84.1	3.0	5.0	5.5	7.0	5.1
Y354H55	2755aa x Y254	45	21.6	75.6	2.0	4.0	4.5	6.5	4.3
3747H8	546H3 x 2747	44	16.6	77.3	4.0	6.0	6.5	7.5	6.0
3747H55	2755aa x 2747	41	9.8	82.9	3.0	4.5	5.5	7.0	5.0
3902H8	546H3 x Y254H53	43	12.2	76.7	3.0	5.0	5.5	7.0	5.1
3902H55	2755aa x Y254H53	45	16.4	80.0	2.0	4.5	4.0	7.0	4.4
Y346H8	546H3 x F82-46	41	8.7	90.2	3.0	4.0	5.0	7.0	4.8
Y346H55	2755aa x F82-46	48	16.5	79.2	2.0	3.5	4.0	6.0	3.9
Y346H96	C796aa x F82-46	44	5.8	86.4	3.0	4.5	6.0	7.0	5.1
Y346H64	1216aa x F82-46	45	9.0	84.4	2.0	4.0	4.5	7.5	4.5
Y246H63	1214aa x Y146	47	8.7	85.1	2.0	4.5	5.0	6.5	4.5
US H11	546H3 x C36	36	4.0	94.4	3.0	6.0	6.5	7.0	5.6
Y346H8	546H3 x F82-46	40	10.0	87.5	2.0	5.5	5.5	7.0	5.0
Y346H3	C562HO x F82-46	42	16.3	69.0	2.0	5.5	5.5	7.0	5.0
Y346H31	F82-301CMS x F82-46	45	20.3	73.3	3.0	5.5	5.5	7.0	5.3
Y246H61	C301aa x Y146	43	25.3	62.8	2.0	4.5	5.5	6.5	4.6
Y246H42	(C301 x C546) x Y146	45	17.5	77.8	2.0	4.0	4.5	6.5	4.3
Y346H72	C718HO x F82-46	44	24.7	59.1	3.0	4.0	6.0	7.0	5.0
Y346H37	C306HO x F82-46	40	26.4	62.5	2.0	3.5	5.5	7.0	4.5

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
HYBRIDS									
Y346H38	C307H0 x F82-46	45	31.4	57.8	3.0	4.0	4.5	7.0	4.6
Y346H42	2802aa x F82-46	55	18.7	72.7	2.0	3.0	4.5	6.5	4.0
Y246H26	F79-779H0 x F82-46	50	21.4	70.0	2.0	3.5	5.0	6.5	4.3
Y246H50-25	1790-SSD-25H26 x Y146	48	21.6	68.8	3.0	3.5	5.0	7.0	4.6
Y246H50-33	1790-SSD-33H26 x Y146	43	22.5	72.1	3.0	4.0	5.0	6.5	4.6
Y246H50-69	1790-SSD-69H26 x Y146	50	17.1	72.0	2.0	4.5	5.0	7.0	4.6
Y246H50-88	1790-SSD-88H26 x Y146	42	13.5	81.0	3.0	5.5	6.0	7.0	5.4
917H8	546H3 x 417 (C17)	41	18.6	78.0	3.0	6.5	6.5	7.0	5.8
Y246H54	1755aa x Y146 (C46)	41	21.0	73.2	2.0	4.5	4.5	7.0	4.5
Y246H55-4	1755-4aa x Y146	45	25.4	66.7	2.0	3.5	4.0	6.0	3.9
Y246H55-21	1755-21aa x Y146	46	14.1	80.4	2.0	3.0	3.5	6.0	3.6
Y246H55-35	1755-35aa x Y146	45	29.1	64.4	2.0	3.0	4.0	7.0	4.0
Y246H55-40	1755-40aa x Y146	45	15.2	77.8	3.0	4.5	6.0	7.5	5.3
Y246H55-57	1755-57aa x Y146	48	26.3	64.6	3.0	4.5	6.0	7.0	5.1
Y246H57-25	1755-25aa x Y146	47	47.1	48.9	2.0	3.0	3.5	6.5	3.8
Y246H57-35	1755-35aa x Y146	43	24.5	62.8	3.0	5.5	6.0	7.0	5.4
OPEN-POLLINATED									
E240	Inc. E640 (C40)	32	98.7	0.0	4.0	5.0	6.0	8.5	5.9
F82-46	Inc. C46 (82459)	43	6.0	86.0	2.0	3.0	4.0	6.0	3.8
Y231H53	747aa x Y131 (C31)	43	13.5	83.7	2.0	4.0	5.0	6.5	4.4
Y246H53	747aa x Y146 (C46)	36	25.9	63.9	3.0	3.5	5.0	6.5	4.5
Y254H53	747aa x 1201-5	37	14.0	78.4	4.0	5.0	5.0	7.0	5.3
3902	Y254H53aa x A	47	15.5	78.7	2.0	4.0	4.0	6.0	4.0
Y339H67	2747aa x Y139	44	12.9	77.3	3.0	4.0	4.5	6.5	4.5
3747	2747aa x A	39	9.9	87.2	3.0	4.5	5.5	7.0	5.0

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
OPEN-POLLINATED									
F82-36	Inc. C36 (82421)	35	0.7	97.1	4.0	4.5	5.5	7.0	5.3
F81-37	Inc. F80-37 (81101)	47	6.3	85.1	4.0	5.5	7.0	7.5	6.0
917	Inc. 417 (C17)	43	65.5	30.2	3.0	5.5	6.5	7.5	5.6
E340	Inc. E240 (C40)	48	96.6	0.0	4.0	5.5	7.0	9.0	6.4
F82-46	Inc. C46 (82459)	42	12.3	83.3	2.0	4.5	5.5	7.0	4.8
964	Inc. 364 (C64)	43	2.7	90.7	2.0	3.5	4.5	7.0	4.3
968	Inc. 468 (US 75)	45	31.2	64.4	3.0	5.0	6.5	7.5	5.5
F78-36	Inc. F77-36 (78087)	45	2.4	93.3	5.0	6.5	7.5	8.0	6.8
335-1	PMR from EDW (C35-1)	44	0.2	97.7	2.0	3.5	4.5	7.0	4.3
335-2	PMR from EDW (C35-2)	49	0.7	89.8	1.0	3.0	5.0	6.5	3.9
335-1/2	PMR from EDW	36	0.2	97.2	2.0	3.5	4.5	5.5	3.9
F80-37	Inc. E937 (C37)	44	2.1	97.7	4.0	5.5	6.5	7.0	5.8
E337	Inc. F81-37	40	2.4	87.5	4.0	6.0	7.5	7.5	6.3
Y323	YR-ER Y123 (C23)	35	5.0	88.6	3.0	4.0	3.5	6.0	4.1
Y326	YR-ER Y126	44	18.6	70.5	2.0	3.0	4.5	7.0	4.1
F83-46	Inc. F82-46 (83010)	45	14.8	80.0	2.0	4.0	4.5	7.0	5.1
S336	Inc. F78-36	36	1.5	86.1	4.0	5.5	6.0	7.0	5.6
S336SS	Inc. C2 036SS	45	7.1	86.7	5.0	5.5	6.5	7.5	6.1
S336ST	Inc. C2 036ST	44	12.8	81.8	4.0	6.0	6.5	7.5	6.0
SY331	Inc. F78-31	47	28.6	66.0	4.0	5.0	5.0	6.5	5.1
SY331SS	Inc. C2 SY131SS	48	19.4	68.8	2.0	4.0	5.0	7.0	5.0
SY331ST	Inc. C2 SY131ST	47	13.9	76.6	3.0	5.0	6.5	7.5	5.5
SY340	Inc. Y940	46	6.5	87.0	2.0	5.0	5.5	7.0	4.9
SY340SS	Inc. C2 Y040SS	43	18.7	74.4	3.0	4.0	5.0	7.0	4.8

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
OPEN-POLLINATED									
SY340ST	Inc. SY140ST	41	17.2	78.0	4.0	6.0	8.0	8.0	6.5
F79-31	Inc. C31E2 (79427)	42	19.7	73.8	2.0	3.5	5.0	6.5	4.3
Y131	YR-ER-PM Y031	31	19.1	67.7	3.0	3.5	4.5	6.5	4.4
Y331	YR-ER Y131 (C31/5)	36	9.8	80.6	2.0	3.0	4.5	6.5	4.0
E240	Inc. E640	37	92.8	0.1	3.0	5.0	7.5	8.0	5.9
Y339	Inc. Y139	41	13.1	85.4	3.0	3.5	5.0	6.5	4.5
Y339	YR-ER Y139	42	5.4	88.1	2.0	3.0	4.0	5.5	3.6
Y356 (3n)	4n x F82-46	46	15.2	78.3	3.0	4.5	6.0	7.0	5.1
E240	Inc. E640	46	93.7	0.0	4.0	5.0	7.0	8.0	6.0
F82-46	Inc. C46 (82459)	40	17.6	77.5	2.0	3.0	3.5	5.0	3.4
F83-46	Inc. F82-46 (83010)	42	9.8	85.7	2.0	3.5	5.5	6.0	4.3
Y346	Inc. F82-46	43	16.7	76.7	2.0	3.5	5.0	6.5	4.3
Y346	YR-ER Y146 (Iso)	43	0.2	97.7	2.0	3.5	4.0	5.5	3.8
Y141	Inc. Y041	43	3.1	90.7	2.0	2.5	3.5	6.0	3.5
Y341	YR-ER Y141 (Iso)	47	5.2	91.5	1.0	2.0	2.0	4.0	2.3
F82-36	Inc. C36 (82421)	42	3.6	92.9	5.0	5.5	5.5	7.5	5.9
Y347	YR-ER Y147	38	4.8	92.1	2.0	4.5	4.0	6.0	4.1
Y348	YR-ER Y148	46	2.2	97.8	2.0	4.0	5.0	6.5	4.4
Y149	Inc. Y049	38	14.5	76.3	3.0	4.0	6.0	7.5	5.1
Y349	YR-ER Y149	39	8.5	84.6	3.0	3.5	5.0	6.5	4.5
Y152	Inc. Y052	43	21.7	69.8	4.0	4.0	5.0	6.5	4.9
Y352	YR-ER Y152	47	5.3	87.2	3.0	4.5	5.5	7.0	5.0
Y254	Inc. 1201-5	38	25.5	63.2	3.0	5.0	6.0	7.0	5.3
Y354	Inc. Y254	43	15.5	76.7	3.0	5.0	5.5	7.0	5.1

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
OPEN-POLLINATED									
Y353	Y253(3n) x F82-46	31	21.9	71.0	2.0	4.0	4.5	7.0	4.4
70026PL	Rhizomania res. Alba	31	33.3	64.5	3.0	3.0	4.5	6.5	4.3
64308PL	Rhizomania res. "	48	27.4	70.8	3.0	4.5	7.0	7.5	5.5
3747	2747aa x A	50	9.4	88.0	3.0	5.5	7.0	7.0	5.6
3218	YR-ER 1218C1	49	4.1	95.9	2.0	2.5	4.0	6.5	4.3
3219	YR-ER 1219C1	49	2.0	98.0	1.0	3.5	4.5	6.5	3.9
3220	YR-ER 1220C1	42	6.3	88.1	2.0	4.0	5.5	7.0	4.6
3221	YR-ER 1221C1	46	8.6	80.4	4.0	5.5	7.0	7.0	5.9
SELF-FERTILE									
3719	Inc. 1717ME, 1719E2	36	17.4	69.4	2.0	4.0	5.0	6.5	4.4
3731	Inc. 2731	45	32.1	66.7	4.0	4.5	6.0	7.5	5.5
3733	Inc. T-O 2733-S_1	42	22.1	71.4	2.0	4.5	6.5	7.5	5.1
3743	9740, 1, 2, 4 & 5aa x A	32	22.2	69.0	3.0	6.0	7.0	7.5	5.9
3796(C796)	Inc. T.O. 2796-S_1	51	3.5	88.2	3.0	6.0	8.0	7.5	6.1
3796	YR-ER 1796 (A,aa)	51	6.3	80.4	4.0	6.5	8.0	8.0	6.6
917	Inc. 417 (C17)	39	67.7	25.6	4.0	5.5	6.0	8.0	5.9
NS-pop-1	Yugo-mm, A:aa	44	37.6	54.5	2.0	5.0	6.0	7.5	5.1
3217	YR-ER 1217 (A,aa)	48	15.3	79.2	2.0	5.5	6.0	7.0	5.1
3216A	Inc. T-O 2216-S_2	51	13.3	80.4	3.0	6.0	6.0	7.5	5.6
F82-546H3	F66-562HO x F78-546	46	12.3	76.1	3.0	6.0	7.5	7.5	6.0
E240	Inc. E640	48	95.8	0.0	4.0	5.5	7.0	8.0	6.1
2755	1755aa x A	47	22.7	70.2	3.0	4.5	6.0	7.0	5.1
3755	YR-ER 1755	51	35.0	58.8	2.0	3.5	6.0	7.0	4.6
3755Z	YR-ER(% S) 1755	51	19.5	74.5	2.0	3.0	4.5	6.5	4.0
3755K	0755-S_1(SY)aa x A	52	32.1	63.5	2.0	5.0	7.5	7.0	5.4

TEST 2984. POWDERY MILDEW AND ERWINIA ROOT ROT OBSERVATION TEST, SALINAS, CA, 1984 (Continued)

192 entries x 2 reps
1-row plots, 20 ft. long

Planted: May 23, 1984
Inoc. Erwinia: Aug. 10, 1984
Harvested: November 1984

Variety	Description	No. Roots	Erwinia Reaction[1] DI	Erwinia Reaction[1] % Resistant	Powdery Mildew Score[2] 8/21/84	8/28/84	9/6/84	9/11/84	Ave.
SELF-FERTILE									
3757	YR-ER 1757, 9	38	35.6	60.5	1.0	4.0	5.0	7.0	4.3
F83-301	Inc. F82-301	49	39.4	53.1	2.0	5.5	6.5	7.5	5.4
F83-306	Inc. C306 (83423)	50	48.4	48.0	2.0	3.0	4.0	7.5	4.1
F83-307	Inc. C307 (83428)	36	55.3	36.1	2.0	4.0	5.0	8.0	4.8
C718	Inc. F74-718 (83246)	49	41.3	49.0	2.0	5.5	6.5	8.0	5.5
F82-562	Inc. C562 (82196)	39	44.5	48.7	2.0	4.5	6.0	8.5	5.3
F82-546	Inc. C546 (82372)	44	18.4	72.7	2.0	5.0	7.5	8.5	5.8
1546HL5	C301CMS x C546	46	21.1	69.6	3.0	6.0	7.5	8.0	6.1
2790-2	1790D-2⊗	49	13.5	79.6	3.0	5.5	6.5	6.5	5.4
2790-41	1790D-41⊗	51	37.6	52.9	3.0	5.0	5.0	7.0	5.0
2790	1790aa x A	40	23.9	70.0	2.0	4.5	4.5	7.0	4.5
3755Z	YR-ER(% S) 1755	45	11.0	86.7	2.0	3.5	4.5	7.0	4.3
F82-546	Inc. C546 (22372)	46	6.4	91.3	3.0	5.5	7.5	8.0	6.0
F83-301CMS	C301CMS x C301 (83304)	44	46.0	47.7	4.0	6.0	7.0	7.0	6.0
3755-22	Inc. 0755-22	31	29.5	64.5	2.0	3.5	4.0	6.0	3.9
3755-46	Inc. 0755-46	52	3.4	94.2	4.0	6.5	8.0	8.0	6.6
3805A	Inc. 2805 (C304)	45	41.5	46.7	3.0	5.0	6.5	7.0	5.4
3806A	Inc. 2806 (C305)	42	78.9	14.3	1.0	3.5	5.0	7.5	4.3
3809A	Inc. 2809 (C302)	40	31.5	52.5	1.0	3.0	4.5	7.0	3.9
3810A	Inc. 2810 (C303)	45	66.9	24.1	2.0	3.5	4.5	6.5	5.1
3811A	Inc. 0755-16	50	36.2	58.0	1.0	2.5	3.5	6.0	3.3
3812A	Inc. 0755-26	47	14.8	80.9	1.0	3.0	4.5	7.0	3.9
3813A	Inc. 0755-51	46	29.2	65.2	1.0	2.5	4.0	7.0	3.4
3814	0755-70aa x A-	51	30.3	64.7	1.0	1.5	3.5	6.0	3.0

TEST 3084. VARIETY EVALUATION FOR ERWINIA ROOT ROT AND POWDERY MILDEW, SALINAS, CA, 1984

36 entries x 4 replications
1-row plots, 20 ft. long

Planted: May 25, 1984
Inoc. Erwinia: August 10, 1984
Harvested: November, 1984

Variety	Description	No. Roots per Plot	Erwinia Reaction[1/]		Powdery Mildew Score[2/]				
			DI	% Resistant	8/21/84	8/28/84	9/6/84	9/11/84	Avg.
HH-1	HH23	24	15.7	75.9	2.5	4.0	5.3	6.8	4.7
HH-2	HH27	26	6.7	84.4	2.5	3.3	4.8	5.5	4.0
HH-3	HH38	26	14.6	71.7	2.0	4.0	5.3	6.5	4.5
HH-4	HH37	26	19.3	68.4	2.5	4.3	5.8	7.5	5.0
HH-5	HH40	27	14.0	80.2	2.5	3.8	5.8	6.8	4.7
HH-6	81-5323-02	22	27.4	65.4	2.0	4.0	5.3	6.8	4.5
HH-7	81-7335-06	24	15.3	75.6	2.5	4.3	6.5	7.3	5.2
HH-8	83C116-02	24	5.6	90.5	2.5	4.3	6.3	6.8	5.0
HH-9	83C21-08	22	29.9	56.9	2.0	4.0	6.0	7.5	4.9
HH-10	83C21-012	24	19.1	69.3	3.0	3.8	6.3	7.8	5.3
HH-11	83C117-04	22	8.2	85.6	3.5	4.5	7.0	7.8	5.7
HH-12	83C117-05	18	13.7	69.6	2.5	4.8	7.0	7.8	5.5
GW-1	Monohy 55	25	12.1	78.6	2.5	4.0	5.8	7.0	4.8
GW-2	Monohy 82MSC148	25	18.0	63.0	2.0	4.0	5.8	7.5	4.8
GW-3	82MSC151	22	16.1	73.5	3.0	4.0	5.5	7.8	5.1
AS-1	WS-88	25	34.6	49.7	4.0	5.5	7.8	8.5	6.5

1/, 2/ See footnotes for Test 2984.

TEST 3084. (Continued)

36 entries x 4 replications
1-row plots, 20 ft. long

Planted: May 25, 1984
Inoc. Erwinia: August 10, 1984
Harvested: November, 1984

Variety	Description	No. Roots per Plot	Erwinia Reaction		Powdery Mildew Score				
			DI	% Resistant	8/21/84	8/28/84	9/6/84	9/11/84	Avg.
USC-1	USC-1	23	12.4	79.2	2.0	3.8	5.0	7.0	4.5
USC-2	USC-2	26	6.3	84.0	3.5	5.3	7.8	8.0	6.2
USC-3	USC-3	23	7.4	80.8	3.0	3.5	6.0	7.3	5.0
SS-1	SS-NB2	26	6.0	90.5	3.0	4.5	6.5	7.5	5.4
SS-2	SS-LS2	24	2.4	91.9	2.5	4.3	5.8	7.5	5.0
SS-3	SS-E1	20	3.0	85.4	3.5	5.0	7.3	8.0	6.0
SS-4	SS-E2	22	1.2	94.7	3.0	4.5	6.8	8.3	5.7
SS-5	SS-Y1	25	6.5	82.7	3.0	4.8	7.0	7.8	5.7
SS-6	SS-Z1	22	13.1	76.4	3.5	5.0	6.5	7.8	5.7
SS-7	SS-Z2	24	7.2	85.4	3.0	4.8	7.5	8.5	6.0
US H11	Check (282110)	24	2.6	88.7	3.5	5.3	7.5	8.3	6.2
US H11	Check (282110)	21	1.7	90.1	3.5	5.3	7.5	8.0	6.1
US H11	Check (282110)	24	4.8	87.8	3.5	4.8	7.5	8.0	6.0
US H11	Check (282110)	24	3.5	90.4	3.5	5.0	7.3	8.3	6.0
US H11	Check (282110)	27	2.1	88.1	3.5	5.0	7.8	8.8	6.3
US H11	Check (282110)	22	1.0	94.4	4.0	5.0	7.8	8.3	6.3
E340	Check Inc. E240	22	89.5	6.3	3.0	4.8	7.3	8.5	5.9
E340	Check Inc. E240	23	85.8	4.2	4.0	4.8	7.3	8.8	6.2
917H8	Check 546H3 x C17	24	25.0	60.4	3.0	4.8	7.0	7.8	5.7
917H8	Check 546H3 x C17	27	20.4	62.9	3.5	5.3	7.8	7.8	6.1
LSD (0.05)			8.8						
C. V. (%)			39.6						
F value			38.9						

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1984
150 entries x 2 replications

Variety	Description	CT Rating 8/13 RI	CT Rating 8/13 RII	CT Rating 9/17 RI	CT Rating 9/17 RII
HYBRIDS					
Checks	US 41, US 33	-	2.4	-	5
US H11	(C562CMS x C546) x C36	-	2.8	-	3
Y246H50-25	(C779CMS x 790-25) x C46	2.3	2.6	4	3
Y246H50-33	(C779CMS x 790-33) x C46	2.6	2.7	4	4
Y246H50-69	(C779CMS x 790-69) x C46	2.5	3.0	3	5
Y246H50-88	(C779CMS x 790-88) x C46	1.5	3.0	3	4
Y246H55-4	S_1 755-4aa x C46	2.6	3.2	3	5
Y246H55-21	S_1 755-21aa x C46	2.4	3.1	4	4
Y246H55-35	S_1 755-35aa x C46	2.7	2.9	3	3
Y246H55-40	S_1 755-40aa x C46	1.8	3.2	3	4
Y246H55-57	S_1 755-57aa x C46	2.2	2.8	3	3
Checks	US 33, US 41	3.1	2.7	5	3
Y246H57-25	S_1 757-25aa x C46	1.7	2.9	2	3
Y246H57-35	S_1 757-35aa x C46	2.4	3.1	4	4
Y346H97-22	S_1 796-22aa x C46	2.1	2.7	3	4
Y346H96	796aa x C46	3.9	3.1	4	4
Y231H19	796CMS x C31E1	4.6	3.1	5	3
US H10B	(C562CMS x C546) x C17	3.0	3.3	4	4
964H8	(C562CMS x C546) x C64	3.9	3.1	3	4
USC-1	83348	2.1	3.1	3	4
USC-2	83048	2.1	3.0	3	4
USC-3	83417	3.9	4.0	5	5
Checks	US 41, US 33	2.4	3.9	4	5
HH 37	Holly	3.4	3.1	6	5
SS-NB2	Spreckels	2.4	3.4	5	5
SS-1	Spreckels	1.8	2.9	2	4
SS-2	Spreckels	3.1	3.9	4	4
SS-3	Spreckels	3.5	3.6	5	4
Y231H8	(C562CMS x C546) x C31E2	3.2	3.4	5	5
Y339H8	(C562CMS x C546) x Y39	2.0	3.6	3	4
Y346H8	(C562CMS x C546) x C46	1.9	3.4	3	5
Y354H8	(C562CMS x C546) x Y54	1.8	3.2	3	4
E337H8	(C562CMS x C546) x C37	1.6	3.2	2	4
Checks	US 33, US 41	2.6	3.0	3	4
3747H8	(C562CMS x C546) x 747	1.8	3.4	3	5
3902H8	(C562CMS x C546) x 902	1.7	2.8	3	4
US H11	(C562CMS x C546) x C36	2.1	2.5	4	3
704-13H24	(C536CMS x C522) x 04-13	1.7	2.9	3	4
KW 1132	KWS-Betaseed	2.4	3.9	5	6
Monodoro	Hilleshog	3.4	4.1	6	5

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1984
150 entries x 2 replications

Variety	Description	CT Rating 8/13 RI	CT Rating 8/13 RII	CT Rating 9/17 RI	CT Rating 9/17 RII
HYBRIDS					
Y346H3	C562CMS x C46	1.3	2.9	3	3
Y346H72	C718CMS x C46	1.6	2.7	2	3
Y246H61	C301aa x C46	1.7	2.5	3	4
Y246H42	(C301CMS x C546) x C46	1.7	2.1	2	3
Checks	US 41, US 33	2.0	3.5	3	5
Y346H64	1216aa x C46	2.6	1.4	3	3
Y346H31	C301CMS x C46	2.2	1.6	4	3
Y346H37	C306CMS x C46	2.1	2.3	3	3
Y346H38	C307CMS x C46	3.1	1.2	4	3
Y346H55	755aa x C46	3.3	1.8	5	3
3747H55	755aa x 747	3.6	1.4	5	3
3902H55	755aa x 902	3.0	2.4	4	4
E337H55	755aa x C37	3.0	1.4	5	3
E337H16	755CMS x C37	2.4	1.5	3	3
E337H3	C562CMS x C37	2.2	1.1	3	2
Checks	US 33, US 41	3.8	1.6	6	3
E337H72	C718CMS x C37	2.3	1.2	4	3
E337H21	(C718CMS x C301) x C37	2.3	2.7	3	4
E337H22	(C301CMS x C546) x C37	1.7	2.0	3	4
E337H23	(C718CMS x C546) x C37	2.4	1.8	3	3
E337H31	C301CMS x C37	2.2	1.3	3	2
E137HL6	C301aa x C37	2.9	2.0	4	2
E337H45	C304aa x C37	2.5	2.1	4	3
E337H46	C305aa x C37	2.6	2.1	4	3
E337H47	C306aa x C37	2.4	2.0	3	3
E337H48	C307aa x C37	2.0	2.2	3	3
Checks	US 41, US 33	3.3	2.5	4	4
E337H49	C302aa x C37	2.6	1.4	4	3
E337H50	C303aa x C37	2.8	2.2	4	3
OPEN-POLLINATED LINES					
Y009	US 22/3	2.3	2.2	4	3
968	US 75	1.7	2.9	3	4
917	C17	2.8	2.6	4	3
F80-37	C37	2.5	2.2	5	3
F81-37	C37	2.1	2.5	4	3
F78-36	C36	2.9	1.4	4	2
F82-36	C36	2.5	1.1	4	2
E337	C37	2.9	1.4	4	3

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1984
150 entries x 2 replications

Variety	Description	CT Rating 8/13 RI	8/13 RII	9/17 RI	9/17 RII
OPEN-POLLINATED LINES					
Checks	US 33, US 41	3.1	1.4	5	3
964	C64	2.9	1.2	4	3
F79-31	C31	5.9	2.0	7	4
Y331	C31E4	5.4	1.8	6	4
F82-46	C46	2.1	1.6	3	3
F83-46	C46	2.8	1.6	3	3
Y346	C46	2.5	1.4	4	3
Y246H53	747aa x C46	2.9	2.3	4	3
3747	747	3.1	1.4	4	3
3902	902	3.1	1.4	4	3
Y354	Y54	3.5	1.1	4	3
Checks	US 41, US 33	2.8	2.0	4	4
Y356 (3n)	4n x C46	3.6	2.0	5	3
Y353	3n x C46	3.7	2.2	6	3
3101	Chinese NS-358	5.4	3.0	7	3
3107-6	Chinese accessions	6.0	3.4	8	4
Y323	C23	4.5	3.6	7	4
Y326	Y26	2.9	2.2	6	3
Y339(I)	Y39	5.7	3.0	8	3
Y339	Y39	2.7	2.7	6	5
Y339H67	747aa x Y39	3.2	2.0	5	4
Y341	Y41	3.2	2.9	6	4
Checks	US 33, US 41	3.6	1.7	6	3
Y347	Y47	3.3	2.3	6	3
Y348	Y48	2.9	2.8	5	3
Y349	Y49	4.6	2.5	6	4
Y352	Y52	2.7	2.9	5	4
70026PL	Alba	6.2	5.2	9	5
64308PL	Alba	5.8	4.9	8	5
SELF-FERTILE LINES					
3731	731	3.2	3.3	6	4
3733	733	2.4	4.4	4	3
3743HO	743CMS x 743	3.2	2.7	4	3
2797	797	1.9	2.6	3	3
Checks	US 41, US 33	3.2	3.6	4	4
2790	790	2.7	3.7	6	4
2790-2	C790-2	4.1	4.9	6	5
2790-41	C790-41	2.4	3.0	5	3

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1984
150 entries x 2 replications

Variety	Description	CT Rating 8/13 RI	CT Rating 8/13 RII	CT Rating 9/17 RI	CT Rating 9/17 RII
SELF-FERTILE LINES					
2790-42	C790-42	2.3	2.8	5	3
2790-55	C790-55	3.6	4.0	7	3
2790-65	C790-65	3.4	2.5	6	3
2790-68	C790-68	4.0	2.6	6	4
2796-15	796-15⊗	3.6	3.1	5	4
3796	796	2.5	2.6	4	4
3796(I)	C796	2.7	2.5	4	3
Checks	US 33, US 41	5.0	3.2	6	4
3212H31	C301CMS x 212	2.8	3.0	4	3
3214A	214	3.5	3.0	6	4
3216A	216	4.1	3.0	5	3
2217A	217	3.3	3.0	4	4
Checks	US 33, US 41	4.8	2.9	5	5
3755KH67	747aa x 755	3.3	3.2	4	4
3757	757	3.4	3.0	5	3
3755Z	755 (% S)	3.7	3.0	5	3
F83-301	C301	4.5	3.4	5	4
F83-301CMS	C301CMS	3.3	2.9	5	3
F83-306	C306	3.2	2.6	3	3
F83-306CMS	C306CMS	3.4	2.8	4	3
F83-307	C307	3.4	3.3	4	4
F83-307CMS	C307CMS	3.0	3.3	3	4
3805A	C304	3.8	3.1	6	4
Checks	US 41, US 33	3.2	3.4	3	4
3806A	C305	3.4	3.3	4	6
3809A	C302	3.4	3.2	4	6
3810A	C303	3.4	2.9	4	3
3811A	755-16	3.4	2.6	4	4
3812A	755-26	3.5	3.1	5	4
3813A	755-51	3.9	2.8	5	4
Checks	US 33, US 41	4.1	3.7	5	5
3814A	755-70	3.5	3.4	6	4
3755-22	755-22	3.6	3.3	6	4
3755-46	755-46	3.7	3.0	6	4
F83-718	C718	3.4	3.1	4	4
F83-718HO	C718CMS	3.2	2.7	4	4
F78-546	C546	3.4	3.3	4	5
F82-546	C546	3.4	3.1	4	5
F82-562	C562	3.4	3.0	4	4
F82-562HO	C562CMS	3.6	2.3	4	4

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1984
150 entries x 2 replications

Variety	Description	CT Rating 8/13 RI	CT Rating 8/13 RII	CT Rating 9/17 RI	CT Rating 9/17 RII
SELF-FERTILE LINES					
F81-566	C566	3.3	2.6	4	4
Checks	US 41, US 33	3.2	2.9	3	4
8563	C563	3.5	3.0	4	5
7522H21	C536CMS x C522	3.2	2.2	4	4
F78-546H3	C562CMS x C546	3.0	2.6	3	3
F82-546H3	C562CMS x C546	3.0	2.5	3	4
1546H72	C718CMS x C546	3.0	2.4	3	3
1546HL5	C301CMS x C546	2.9	2.4	3	4
3218	218	4.1	3.8	5	4
3219	219	3.2	2.9	5	3
3220	220	3.0	3.1	3	4
3221	221	3.2	2.3	4	3

SCREENING TEST FOR REACTION TO RHIZOMANIA

R. T. Lewellen and I. O. Skoyen

A relatively small area with known rhizomania infestation was available in 1984 at Salinas to screen germplasm for reaction to this disease. Eighty entries with two replications were grown. Some entries were composites of similar lines or lines from one location. Hybrids Mono 1167, Monodoro, and Mono 4086 from Hilleshog and lines 70026PL and 64308PL from Alba were included as checks.

The disease development was severe. However, field variability was evident during early growth stages but appeared to even out by the end of the season. Root and top growth was slow and most plants remained small. Considerable tip rot and root rot developed toward the end of the season. Many of the entries were highly susceptible and do not warrant further evaluation. However, some entries showed considerable variation and degrees of resistance or tolerance and will be reevaluated in larger plots in 1985.

The data for the rhizomania scores should be viewed as preliminary and only a general guide to possible sources of variability for tolerance or resistance.

In general, the scores were based upon a visual scale of 0 to 6 and each plot was given an average rating. However, in some instances where obvious differences were great enough, a range in scores was given. The visual scores were based upon relative size, shape, color, root proliferation, etc., where:

0 = No visual symptoms.

1 = Nearly normal taproot growth. Minor bearding. Root not abnormally discolored. Root not brittle. Little or no apparent damage.

2 = Taproot slightly to moderately constricted. Moderate bearding of feeder roots. Moderate taproot discoloration. Taproot slightly to moderately brittle. Relatively little adhering soil. Or similar symptoms on lateral roots.

3 = Taproot "wine-glass" shaped. Feeder roots bearded. Taproot discolored and brittle. "Callus" formation where feeder roots proliferate. Soil adheres to bearded area. Or similar classical symptoms on primary lateral roots.

4 = Damage to taproot severe. Taproot present but probably not functional. Taproot necrotic, highly discolored. Severe bearding of root just below crown. Significant amounts of adhering soil and very high soil tare. Soil not easily removed.

5 = Severe bearding and stunting. Taproot destroyed below the crown or crow-root transition zone. Root necrotic and root rot common. Root area primarily ball of adhering soil and dead feeder roots. Advanced stage of disease just short of plant collapse.

6 = Dead. Probably due to rhizomania, tip root rot, their interaction, or other rhizomania associated causes.

We wish to acknowledge Dr. Hecker, Ft. Collins, Dr. Theurer, E. L., Dr. Doney, Fargo, and Dr. Coe, Beltsville, among others for furnishing many of the lines for this test.

SCREENING TEST FOR REACTION TO RHIZOMANIA, SALINAS, CA, 1984

80 entries x 2 reps
1-row plots, 15 ft.

Planted: May 22, 1984
Evaluated: November, 1984

Source	Variety	Description	Rhizomania Score Rep I	Rhizomania Score Rep II
Ore	US H11	C546H3 x C36	4	4
Union	USC-1	Bonetti	5	4
"	USC-2	"	4	3
"	USC-3	"	4	4
Holly	HH37	82C93-02	4	3
Beta	KW1132	Quinn	5	4
"	EXP 512	Quinn	4	4
"	3G5008	Quinn	4	3
Hill.	Monodoro	Tornebrandt	4	2-4
Sprec.	SSZ1	L80266C	5	3
"	SSNB2	H83327	3+	3-4
F. C.	811012H03	(FC605 x 50212) x 761036HO	4	4
F. C.	811006H02	FC607 x FC608	4	3
Hill.	Mono 1167	Tornebrandt	2-4	2-4
F. C.	781035H01	FC606CMS	3	2-4
"	751105H01	FC506CMS	3-4	4
Hill	Monodoro	Tornebrandt	3-4	3
F. C.	781049	FC901	3-4	4
"	Comp. 3	Composite #3[1/]	4	3
"	" 4	Composite #4[2/]	4	4
Sal.	3107H55	2755aa x Chinese P.I.'s	5	5
Hill.	Mono 1167	Tornebrandt	2-4	3-4
Yugo	Popn.-1	mm from Yugo.	4	5
E. L.	6822-0	SP 6822-0	4+	5
E. L.	M167	Ames N7	4	-
"	0501 37G3	CTR	4	-
"	14159CO	CTR composite	4+	-
"	14K41	CTR composite	5	-
E. L.	37JZ	CTR 51 composite	4	-
"	1200	Doney	5	-
"	7225-3	High yield composite	2-4	-
Hill.	Mono 4086	Tornebrandt	3	-

Source	Variety	Description	Rhizomania Score Rep I	Rhizomania Score Rep II
E. L.	29F23	Red, Smooth root	3+	4
"	35F1-2	35E-popn	4	2-5
"	441239	36D1-popn	3	3
"	2KZ	25A2 root maggot	4	5
Hill.	Mono 4086	Tornebrandt	4	4
E. L.	Comp-1	EL 31, 36, 40, 42	3-5	2-6
"	" -2	82B4-2-83B1-17	4+	4
"	" -3	L5-L61	4-5	5
Sal.	Y331	C31/5	3-4	2-5
"	Y339(Iso)	Y39	2-4	2-4
"	Y341	Y41	3-4	2-4
Italy	70026PL	A16a	3-4	3
Sal.	Y347	Y47	3-4	3-4
"	Y348	Y48	2-4	3-4
"	Y353	3n x C46	3-4	2-4
"	Y354	Y54	2-5	3-4
Ore.	F81-37	C37	4-5	4
Sal.	Chinese Com.	3101-3106	5	3
Italy	70026PL	Alba	4	2-4
Logan	L303	Doney	5	4
Ore.	F83-46	C46	5	4
FC	A59-1	SLC $15BB_2$	4-5	2-5
"	A60-2	Amer #2mm	4	3-4
Italy	64308PL	Alba	4	3-4
FC	A56-3	GW-359-52R	4	3
"	A54-6	Midwest 391	3-5	4-5
"	A55-1	US 201	-	-
"	A69-32	GWmm	3-5	4
FC	A54-7	Amer #2MM	4	3
"	Comp 1	Composite 1[3/]	4-5	3
Italy	64308PL	Alba	2-4	4
FC	Comp 2	Composite 2[4/]	4	3
France	Alba	Dumont	2-4	3
Sal.	3902	Y254H53aa x A	3	2-4
"	3217	Popn-217(A,aa)	4	4
"	3743	743aa x A	4	4
Sal.	3747	2747aa x A	3-5	3
"	3755	1755(A,aa)	4	4
"	3796A	C796	5	4
"	9211	Inc. 7235Cb	4	5

Source	Variety	Description	Rhizomania Score Rep I	Rep II
Sal.	9212	Inc. 7235cbcb	4	2-4
"	9213	Inc. 7236Cb	5-6	4
"	9214	Inc. 7236cbcb	3-4	4
Belt.	Sp 82250-0	Coe	4	3-4
Belt.	Sp 83301-00	Coe	4	4
"	Sp 83302-00	Coe	4	4
Ore	F83-301	C301	5	4+
"	F83-306	C306	5	4+

1/ FC #3: 781084, 781066H, 811049H, 821088, 811056H

2/ FC #4: A79-68, 821036H03, 821036H07, 811010H2

3/ FC #1: A54-4, A55-4, A58-4, A63-1, A64-4

4/ FC #2: Acc. 2168, 2383, 2475

Table 1: Sugarbeet root toughness comparison for high and low fiber root selections and their hybrids, 1984

Line or Hybrid No.	Description	Test 584-1, Seeded 12/22/83 Roots Probed [3] (Scale of 1 to 28+ lbf)[5] No. Roots	Pop. Mean[4]	Roots 28+ 28+/N		Rot	Test 584-2, Seeded 4/12/84 Roots Probed Scale of 1 to 28+ lbf) No. Roots	Pop. Mean	Roots 28+ 28+/N		Rot
		N	lbf	No.	%	%	N	lbf	No.	%	%
336	Inc. F78-36 (P)[2]	133	20.39bc	2	1.5	0.8	134	20.07c	3	2.2	0
336H72	718HO x P	125	19.34cd	1	0.8	0	149	19.80cd	3	2.0	0
336H8	546H3 x P	111	19.47cd	0	0	0	145	19.70cd	2	1.4	0
336S[1]	Inc. 136S	98	19.39cd	1	1.0	0	144	19.62cde	0	0	0
336S-2[1]	2nd sel 036S	112	19.75bc	0	0	0	163	18.96def	0	0	0
336SH72	718HO x S (TX)[2]	100	18.05d	0	0	0	142	18.51f	0	0	0.7
336SH8	546H3 x S	139	19.47cd	1	0.7	0.7	152	18.78ef	0	0	0
336T	Inc. 136T	141	22.37a	37	26.2	1.4	159	22.87a	24	15.1	0
336TH72	718HO x T (TX)	127	20.34bc	0	0	0	137	20.12c	1	0.7	0
336TH8	546H3 x T	121	21.23ab	4	3.3	0	160	21.24b	3	1.9	0
Group 1 Mean			19.97					19.96			
LSD (.05)			1.49					0.92			
C. V. (%)			5.15					3.2			
F value			5.29**					16.50**			
Y331	Inc. F79-31 (P)	92	20.03d	0	0	0	118	19.58cd	1	0.8	0
Y331H72	718HO x P	125	19.77d	1	0.8	0	147	19.31cd	0	0	1.4
Y331H8	546H3 x P	128	20.02d	1	0.8	0	142	20.10bc	2	1.4	0
Y331S	Inc. Y131S	75	20.48cd	1	1.3	1.3	131	19.41cd	0	0	2.3
Y331S-2	2nd sel. Y131S	115	19.55d	0	0	2.6	147	18.80d	0	0	0
Y331SH72	718HO x S	123	19.57d	0	0	0	147	18.69d	0	0	0.7
Y331SH8	546H3 x S	130	20.20d	0	0	0.8	158	18.60d	0	0	0.6
Y331T[1]	Inc. Y131T	127	21.65b	5	3.9	0	155	21.08b	1	0.6	0
Y331T-2[1]	2nd sel Y131T	111	23.84a	22	19.8	1.8	129	24.53a	34	26.4	0.8
Y331TH72	718HO x T	87	19.88d	0	0	0	152	20.80b	0	0	0.7
Y331TH8	546H3 x T	124	21.26bc	1	0.8	0.8	171	20.96b	6	3.5	0
Group 2 Means			20.56					20.17			
LSD (.05)			0.97					1.01			
C. V. (%)			3.27					3.45			
F value			14.29**					24.01**			

[1] S and S-2 = 1st and 2nd cycle selections for low fiber, T and T-2 = 1st and 2nd cycle for high fiber.
[2] P = parent, TX = test cross
[3] Root probes were made with an Effegi penetrometer equipped with a 1 x 10mm blade (10 sq. mm area) x 2.54 cm.
[4] Test means followed by common letter are not significantly different at the 5% level - DMR test.
[5] lbf = pound force.

Table 1: (Continued)

Line or Hybrid No.	Description	Test 584-1, Seeded 12/22/83 — Roots Probed (Scale of 1 to 28+ lbf)					Test 584-2, Seeded 4/12/84 — Roots Probed (Scale of 1 to 28+ lbf)				
		No. Roots	Pop. Mean	Roots 28+ 28+/N		Rot	No. Roots	Pop. Mean	Roots 28+ 28+/N		Rot
		N	lbf	No.	%	%	N	lbf	No.	%	%
Y340	Inc. Y940 (P)	143	20.35b	1	0.7	0	150	19.43c	0	0	0
Y340H72	718HO x P	141	19.48c	1	0.7	0	159	19.06c	0	0	0
Y340H8	546H3 x P	130	20.42b	0	0	0	155	19.18c	0	0	0
Y340S	Inc. Y140S	143	19.07c	0	0	0	153	18.16d	0	0	0
Y340S-2	2nd sel. Y040S	104	17.37d	0	0	0.9	141	17.32e	0	0	0
Y340SH72	718HO x S	107	18.59c	0	0	0.9	149	19.16c	0	0	0.7
Y340SH8	546H3 x S	126	19.18c	0	0	0	165	19.24c	0	0	0
Y340T	Inc. Y140ST	128	22.87a	12	12.5	0.8	137	21.07b	4	2.9	0.7
Y340T-2	2nd sel. Y040T	86	22.48a	5	5.8	2.3	146	23.06a	5	3.4	0
Y340TH72	718HO x T	137	20.53b	1	0.7	0	143	19.55c	0	0	0
Y340TH8	546H3 x T	134	21.00b	3	2.2	0	142	21.11b	1	0.7	0
Group 3 Means			20.12					19.67			
LSD (.05)			0.83					0.74			
C. V. (%)			2.85					2.6			
F value			32.30**					36.78**			
Test Means			20.23					19.93			
LSD (.05)			1.08					0.89			
C. V. (%)			3.81					3.17			
F value			12.44**					22.61**			

Table 1: (Continued)

Line or Hybrid No.	Frequency Distribution of Root Toughness (lbf)[1/] Test 584-1, Seeded 12/22/83 12-14	15-17	18-20	21-23	24-26	27-28+	12-20 Classes Total Probed %	Test 584-2, Seeded 4/12/84 12-14	15-17	18-20	21-23	24-26	27-28+	12-20 Classes Total Probed %
336	6	25	33	49	18	2	48.1	3	27	49	35	15	5	58.9
336H72	5	30	53	23	11	3	70.4	3	34	51	44	15	3	59.7
336H8	7	28	32	32	10	1	60.4	7	24	61	36	14	3	63.4
336S	5	21	33	33	5	1	60.2	3	27	61	43	10	0	63.2
336S-2	3	28	34	35	11	1	58.0	6	38	78	34	7	0	74.8
336SH72	8	31	47	13	1	0	86.0	6	41	68	24	3	0	81.7
336SH8	4	31	56	35	12	1	65.5	7	37	72	30	6	0	76.3
336T	0	5	16	41	38	41	14.9	0	9	30	49	45	26	24.5
336TH72	1	19	45	46	16	0	51.2	4	22	45	52	12	2	51.8
336TH8	0	10	39	49	18	5	40.5	1	16	42	66	32	3	36.9
Group 1 Mean							55.5							59.1
Y331	2	18	27	33	12	0	51.1	2	27	46	34	7	2	63.5
Y331H72	5	23	44	45	7	1	57.6	3	17	69	41	5	0	60.5
Y331H8	1	22	53	40	11	1	59.4	0	22	65	36	17	2	61.3
Y331S	1	11	26	26	10	1	50.7	4	24	60	37	6	0	67.2
Y331S-2	4	21	46	34	10	0	61.7	5	32	77	33	0	0	77.6
Y331SH72	1	28	54	30	10	0	67.5	4	40	73	25	5	0	79.6
Y331SH8	3	24	38	50	14	1	50.0	4	46	79	25	4	0	81.6
Y331T	3	8	33	44	29	9	34.6	0	11	55	60	25	3	42.6
Y331T-2	0	3	23	18	39	28	23.4	0	2	14	27	44	42	12.4
Y331TH72	1	13	24	36	13	0	43.7	1	10	63	59	19	0	48.7
Y331TH8	0	11	39	47	25	2	40.3	1	15	67	56	25	7	48.5
Group 2 Mean							49.1							58.5
Y340	1	25	49	47	20	1	52.4	0	24	84	36	6	0	72.0
Y340H72	5	31	52	42	10	1	62.4	1	35	85	36	2	0	76.1
Y340H8	0	19	44	53	14	0	48.5	1	37	74	38	5	0	72.3
Y340S	4	38	57	35	9	0	69.2	5	59	67	18	4	0	85.6
Y340S-2	13	35	45	10	1	0	89.4	16	58	56	10	1	0	92.2
Y340SH72	2	41	38	23	3	0	75.7	4	33	72	30	10	0	73.2
Y340SH8	3	40	43	33	7	0	68.3	0	27	100	35	3	0	77.0
Y340T	0	6	26	41	39	16	25.0	0	9	51	56	15	6	43.8
Y340T-2	1	5	14	28	33	5	23.2	0	4	24	48	63	7	19.2
Y340TH72	3	18	44	51	20	1	47.4	1	22	79	33	8	0	71.3
Y340TH8	0	17	39	50	25	3	41.8	0	8	55	51	27	1	44.4
Group 3 Mean							54.8							66.1

1/ lbf = pound force

Table 2: Yield comparisons for high and low fiber selections, their parents and test cross hybrids, 1984

Line or Hybrid No.	Description[1]	Test 584-1, seeded 12/22/83[2] Acre Yield Sugar	Roots	Sucrose	Beets/ 100'	Test 584-2, seeded 4/12/84 Acre Yield Sugar	Roots	Sucrose	Beets/ 100'
		lbs	Tons	%	Number	lbs	Tons	%	Number
336	Parent (P)	8,613b[3]	25.4c	16.95ab	101	6,823e	24.1cd	14.14b	101
336H72	718HO x P	10,771a	34.3a	15.70b	95	9,589ab	32.8a	14.66ab	112
336H8	546H3 x P	10,738a	31.2ab	17.30a	84	8,409c	27.8b	15.08ab	109
336S	Soft sel. (S)	8,569b	26.5bc	16.13ab	74	8,126cd	26.2bcd	15.53a	109
336S-2	2nd sel S	8,590b	24.9c	17.20a	85	7,228de	23.7d	15.20ab	123
336SH72	718HO x S(TX)	11,000a	33.4a	16.45ab	76	10,000a	33.9a	14.76ab	107
336SH8	546H3 x S	8,790b	25.8c	16.98ab	105	8,174cd	27.5b	14.90ab	115
336T	Tough sel (T)	7,907b	23.7c	16.78ab	107	7,990cd	26.3bc	15.21ab	120
336STH72	718HO x T(TX)	10,785a	33.5a	16.13ab	96	8,014cd	28.3b	14.15b	103
336STH8	546H3 x T	11,325a	33.8a	16.73ab	92	8,640bc	27.7b	15.64a	121
Group 1 Means		9,709	29.3	16.63	91	8,299	27.8	14.92	112
LSD (.05)		1,752	5.12	1.26	32	1,040	2.5	1.24	14.3
C. V. (%)		12.4	12.0	5.2	24	8.6	6.2	5.7	8.8
F value		4.71**	6.05**	NS	NS	7.12**	14.71**	NS	2.31*
Y331	Parent (P)	10,352bcd	29.4bc	17.65a	70	8,385b	26.0de	16.10ab	89
Y331H72	718HO x P	12,447a	36.2a	17.3ab	95	9,403a	30.8ab	15.30cd	111
Y331H8	546H3 x P	11,535ab	32.4ab	17.9a	97	9,240a	28.8bc	16.08ab	107
Y331S	Soft sel (S)	10,693abc	30.6bc	17.6a	57	8,380b	26.1de	16.06ab	99
Y331S-2	2nd sel S	8,418e	23.7d	17.8a	87	7,800b	23.8ef	16.41a	111
Y331SH72	718HO x S	11,137abc	32.2ab	17.3ab	93	9,741a	32.9a	14.84d	111
Y331SH8	546H3 x S	10,246cde	30.0bc	17.3ab	98	9,465a	30.7ab	15.39bcd	120
Y331T	Tough sel (T)	9,315cde	26.6cd	17.6a	96	8,375b	27.4cd	15.26cd	117
Y331T-2	2nd sel T	8,635de	26.4cd	16.5b	84	6,872c	22.4f	15.31cd	98
Y331TH72	718HO x T (TX)	10,673abc	32.3ab	16.5b	66	9,362a	30.9ab	15.18cd	115
Y331TH8	546H3 x T	10,731abc	30.3bc	17.8a	94	9,598a	30.6ab	15.71abc	130
Group 2 Means		10,382	30.01	17.36	85	8,784	28.2	15.60	109
LSD (.05)		1,705	4.79	0.86	22.25	847	2.44	0.71	15.51
C. V. (%)		11.4	11.0	3.42	18.1	6.7	6.0	3.2	9.8
F value		4.15**	4.34**	2.55*	3.52**	9.38	15.48	4.03	4.37

1/ P = Parent, S = Soft (low fiber) selection, T = tough (high fiber) selection and TX = Test cross.
2/ Harvest dates: 584-1 = 10/27/84, 584-2 = 10/31/84.
3/ Test means followed by common letter are not significantly different at the 5% level - DMR Test.

Table 2: (Continued)

Line or Hybrid No.	Description	Test 584-1, seeded 12/22/83				Test 584-2, seeded 4/12/84			
		Acre Yield			Beets/	Acre Yield			Beets/
		Sugar	Roots	Sucrose	100'	Sugar	Roots	Sucrose	100'
		lbs	Tons	%	Number	lbs	Tons	%	Number
Y340	Parent (P)	9,374bc	27.3cd	17.12ab	108	7,865ab	25.6ab	15.38a	113
Y340H72	718HO x P	11,143a	33.7a	16.50abc	107	8,020ab	27.9ab	14.26bc	120
Y340H8	546H3 x P	10,335ab	29.8abcd	17.25a	98	8,225ab	26.9ab	15.31a	117
Y340S	Soft sel (S)	9,215bc	27.9bcd	16.55abc	108	7,414ab	25.3ab	14.60abc	116
Y340S-2	2nd sel S	9,023bc	27.4cd	16.65abc	79	7,199b	24.1b	14.93abc	107
Y340SH72	718HO x S	9,839abc	31.4abc	15.70bc	81	8,220ab	28.8a	14.25c	113
Y340SH8	546H3 x S	9,893abc	29.3abcd	16.88abc	95	8,475ab	28.0ab	15.10ab	125
Y340T	Tough sel (T)	8,639c	25.6de	16.80abc	97	8,130ab	27.4ab	14.80abc	104
Y340T-2	2nd sel T	6,898d	22.1e	15.45c	65	7,335ab	24.1b	15.23a	110
Y340TH72	718HO x T	11,038a	32.6ab	16.90abc	104	7,738ab	26.8ab	14.36bc	108
Y340TH8	546H3 x T	9,913abc	28.7abcd	17.30a	101	8,691a	28.4a	15.28a	108
Group 3 Means		9,573	28.7	16.64	95	7,937	26.7	14.86	113
LSD (.05)		1,457	4.46	1.27	26.73	1,440	3.96	0.85	14.3
C. V. (%)		10.5	10.8	5.3	19.5	12.6	10.3	3.9	8.8
F value		5.50**	4.44**	NS	2.31*	NS	NS	2.19*	NS
Test Mean		9,893	29.3	16.89	90	8,341	27.6	15.14	112
LSD (.05)		1,612	4.47	1.27	26.0	1,177	2.99	1.03	14.14
C. V. (%)		11.60	11.14	5.08	20.46	10.0	7.7	4.8	9.0
F value		4.70**	4.89**	2.08**	2.18**	4.14**	7.11**	2.50**	2.84**

SUGARBEET RESEARCH

1984 Report

Section B

Crops Research Laboratory, Logan, Utah

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Cooperation:

Utah Agricultural Experiment Station

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CONTENTS

ROLE OF TURGOR IN THE REGULATION OF SUCROSE ACCUMULATION IN SUGARBEET TAPROOT TISSUE

Roger E. Wyse

Last year we began a research project to determine the possible effects of cell turgor on sucrose accumulation in the sugarbeet taproot tissue. Tissues which store osmotically active compounds, such as sucrose, must be able to turgor regulate in order to prevent excessive cell turgor. The sugarbeet taproot is a good example of such a sink. During the growing season, the osmotic concentration of the cell sap commonly increases the equivalent of 20 bars solely as a result of sucrose accumulation. Therefore, the tissue must turgor regulate or the turgor pressure within the cell could exceed 20 bars at maturity. We have measured the turgor of intact sugarbeet taproots and know that at maturity the turgor pressure is no more than 5-7 bars. This ability to turgor regulate may be important in determining the sucrose storage potential of various cultivars. Since the accumulation of sucrose requires the energetic transport of sucrose from the cell wall free space into the vacuole, we have determined the effect of cell turgor on the processes.

Kinetics of Sucrose Transport. We have determined the kinetics of sucrose uptake in taproot tissue discs equilibrated in various external osmotica ranging from 0 to 600 milliosmolar. The tissue utilized in these studies had a cell sap concentration in excess of 700 milliosmolar; therefore, positive turgor was maintained in the tissue under all treatment conditions.

When the tissue was equilibrated in buffer, the uptake of sucrose increased in a linear fashion with increasing concentration (Fig. 1).

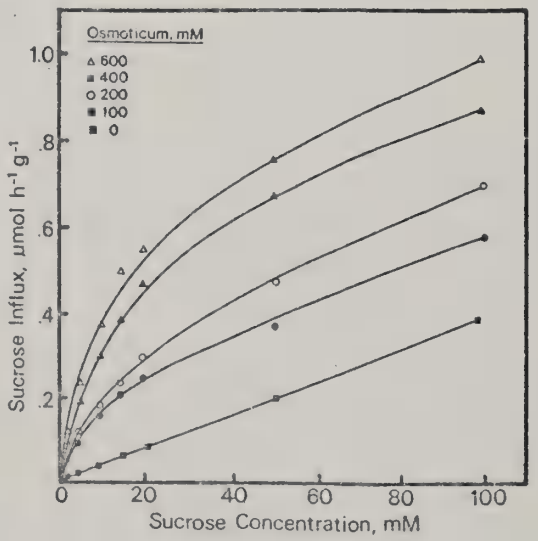

Fig. 1. Kinetic profile of sucrose uptake at various external mannitol concentrations.

As the external osmotic concentration was increased, (the turgor of cells decreased), uptake not only increased, but the saturating component of the kinetic profile increased substantially. These results suggested that the saturating component was very sensitive to cell turgor. When the data are plotted using an Eadie-Hofstee transformation, the two components of uptake become more obvious (Fig. 2). The effect of increasing turgor was to reduce V_{max} from 590 to 290 nmol/gfw/hr for low and high turgor respectively with little change in the Km (12.5 vs 9.0 mM).

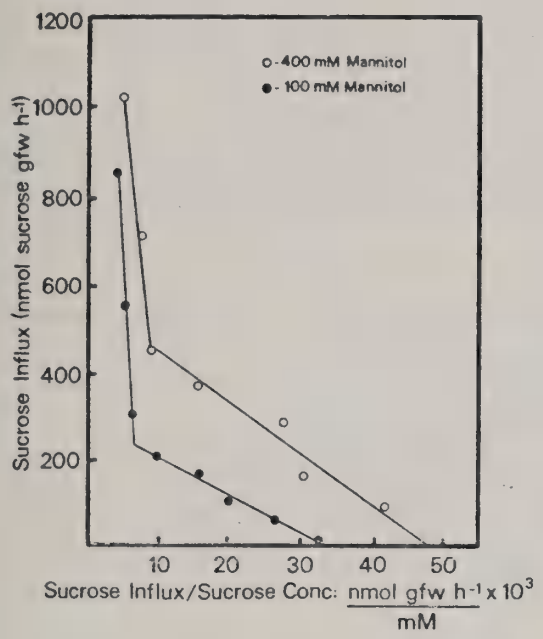

Fig. 2. Replot of kinetic profile at 100 and 400 mM mannitol using the Eadie Hofstee transformation.

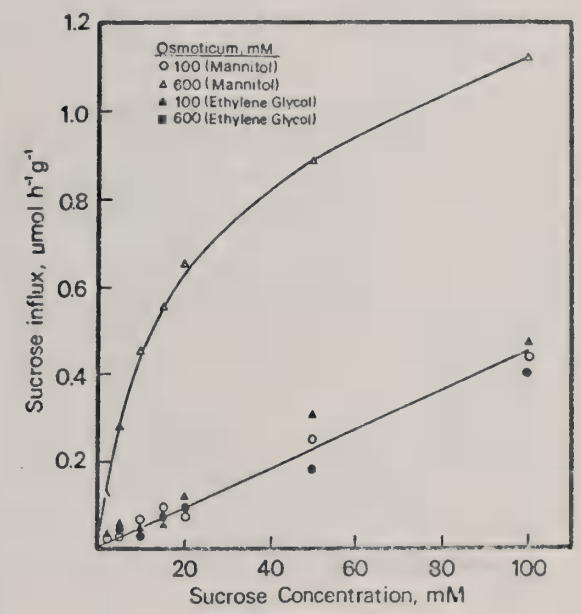

Fig. 3. Comparison of penetrating (ethylene glycol) and non-penetrating (mannitol) osmotica on the kinetics of sucrose uptake.

The water potential of plant cells consists of two components--an osmotic and turgor component. To differentiate between the role of the two components on transport characteristics, we compared a non-permeant osmotica (mannitol) to a permeant osmotica (ethylene glycol). The results are given in Fig. 3. The results clearly show that mannitol greatly enhances, but ethylene glycol has no effect on the saturating component. Thus, the effect of mannitol in the external solution is an effect of turgor on the sucrose transport system. These preliminary results do not differentiate between an effect of turgor directly on the carrier or on the activity of the plasmalemma ATPase.

Since sucrose transport across the plasma membrane is secondary active transport, the effects of turgor on the kinetics of sucrose uptake may be a result of changes in the PMF (proton motive force) resulting from turgor inhibition of the proton pump. To test this possibility, we ran a preliminary experiment to determine the ability of tissue to acidify

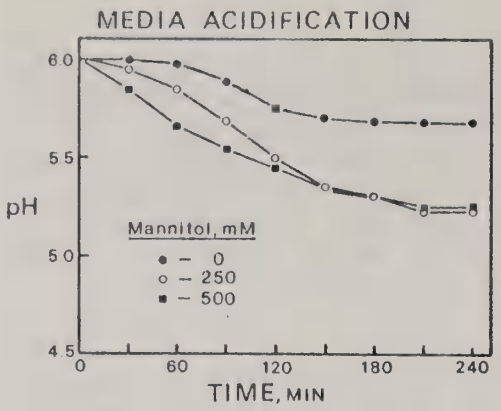

Fig 4. Acidification of the external media by sugarbeet taproot tissue discs at high and low turgor. The tissue was equilibrated in 0.250 or 500 mM unbuffered mannitol for 60 min. At time zero the tissue was placed in fresh media and the external pH monitored over time.

the external media over a range of cell turgors (Fig. 4). The data clearly show that at high turgor both the extent and rate of acidification is inhibited. Thus the changes in kinetic parameters that we observed may be due to the effect of turgor on PMF at the plasma membrane. If the PMF declines through inhibition of the ATPase at high turgor, the membrane would be unable to maintain concentration gradients and, therefore, solutes such as sucrose would leak out. The change in kinetics that we observed were due to changes in V_{max}, which could be explained by changes in the driving force of uptake, i.e. a decline in PMF.

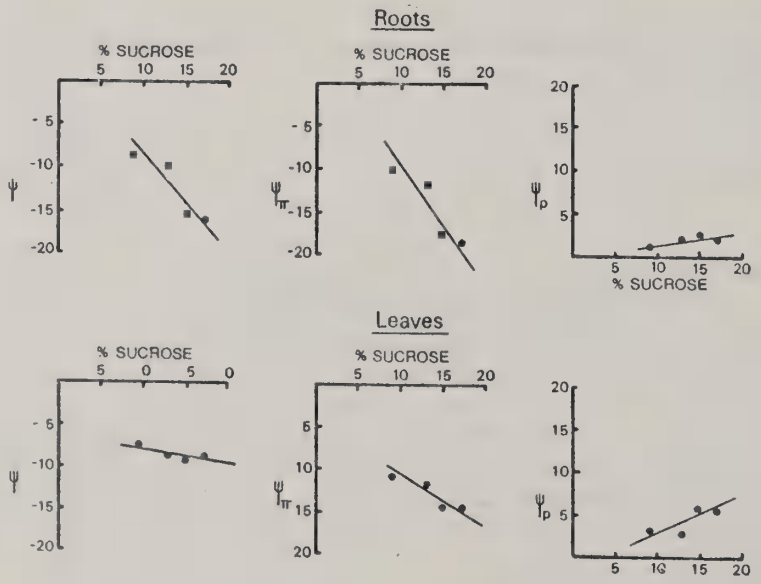

Fig. 5. Water stress parameters in cultivars of Beta vulgaris with a range of sucrose contents. Parameters were determined in field-grown sugarbeets in situ. ψ-water potential, ψ_π -osmotic potential and ψ_p-turgor pressure.

Water Relations in Genotypes of Beta Vulgaris with Widely Divergent Sucrose Contents. The data in Fig. 5 represent the water relations parameters (water potential, osmotic potential, and pressure potential) with varying sucrose content. These measurements were made on both roots and leaves. Note that as the sucrose content increases, water potential declines. This is primarily a result of the decline of the osmotic component, i.e. an increase in solute content of the tissue. The turgor increases only slightly with this decline in water potential. Leaves follow much the same pattern, although the differences are not nearly as great. The results show quite clearly that even though there is a large change in solute content with increasing sucrose concentration, turgor changes only slightly. Therefore, turgor regulation must be occurring in sugarbeet taproots.

Genotypic Differences in the Response of Sucrose Transport to Cell Turgor. Tissue from fodder beet and sugarbeet were used to determine the effect of cell turgor on sucrose uptake (Fig. 6). Tissue was equilibrated in mannitol solutions which were isotonic, i.e. external concentration equaled the concentration of the expressed sap or isotonicity minus 200 mM mannitol or in buffer. The kinetics of sucrose uptake was then determined at these three mannitol concentrations. Sucrose uptake showed biphasic

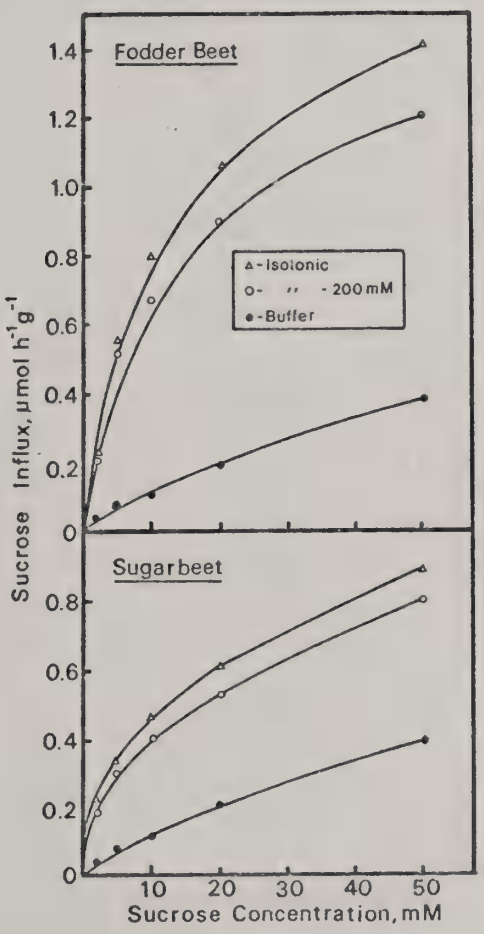

Fig. 6. Kinetics of sucrose uptake in fodder beet and sugarbeet at various cell turgors.

kinetics when the tissue was equilibrated in isotonic or in isotonicity minus 200 mM or approximately 4 bars turgor. Note, however, that the rate of sucrose uptake at isotonicity was 2-fold higher in fodder beet than in sugarbeet. This reduction is an indication of transinhibition of sucrose uptake--an inhibition due to high internal concentrations. Note also that sucrose uptake at high turgor was identical in both tissues. Since the sugarbeet equilibrated in water would be at a much higher turgor than fodder beet equilibrated in water (sugarbeet has higher internal osmotic concentration). The data suggest that fodder beet is more sensitive to high cell turgor than is sugarbeet. We are pursuing this finding to determine whether or not turgor is an important factor influencing sucrose accumulation in these genotypes.

SUGARBEET RESEARCH

1984 Report

Section C

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ABSTRACTS OF PAPERS PUBLISHED OR APPROVED FOR PUBLICATION IN 1984

HECKER, R. J. Reciprocal recurrent selection for the development of improved sugarbeet hybrids. J. Amer. Soc. Sugar Beet Technol. Approved for publication 2/24/84.

Sugarbeet (Beta vulgaris L.) sucrose yield improvement, conditioned by additive and nonadditive gene action, depends on the successful selection of superior combining genotypes. Reciprocal recurrent selection (RRS) was tested as a means of developing populations that combine well together. Two cycles of RRS, with separate emphasis on recoverable sucrose, root yield, and sucrose content, resulted in three populations from each source. The original population A (A CO) was a high sucrose and relatively low root yield cultivar; population B (B CO) was a cultivar with lower sucrose but high root yield. The three A C2 (second cycle) populations generally had higher recoverable sucrose and root yield per se than the original A population, whereas the B C2 populations were improved for sucrose and juice purity, compared to the original B. These results indicated that RRS successfully selected additive gene effects for higher root yield in the low-yield A populations and for higher sucrose in the low-sucrose B populations. The combining ability of A C2 and B C2 populations with each other was superior or equal, never inferior, to A CO X B CO. It was not possible to partition the combining ability of population crosses into components, but the net effect of two cycles of RRS was significantly greater sucrose production in the six A C2 X B C2 hybrids that were tested, compared with the A CO X B CO hybrid. This study indicated that RRS may be an effective breeding method for improving sucrose production of sugarbeet hybrids.

MARTIN, S. S. and G. A. SMITH. Quality components in fodder beets. J. Amer. Soc. Sugar Beet Technol. (Submitted to journal)

Twelve fodder beet (Beta vulgaris L.) cultivars in 1980 and 14 in 1981 were compared to a sugarbeet (Beta vulgaris L.) check cultivar for extracted sucrose, sodium, potassium, and amino nitrogen contents. Sucrose was significantly lower in every fodder beet cultivar relative to the check, with the range among the fodder beet cultivars 50-74% of the check in 1980 and 58-72% in 1981. Sodium content of the fodder beets similarly was significantly greater for each cultivar than that of the check, with a relative range of 320-460% of the check in 1980 and 240-400% in 1981. One fodder beet cultivar in 1980 and seven in 1981 did not differ significantly from the check in extract potassium concentration, and several fodder beet cultivars were significantly lower in amino N concentration than the sugarbeet check. The data are of interest both in examining how long-term selection for different purposes has altered chemical composition in these conspecific plant cultivars, and in considering the potential contribution of a fodder beet cultivar in a possible sugarbeet X fodder beet "all purpose" food and fuel beet.

ROMAGOSA, I., J. M. LASA and R. J. HECKER. 1982. Conversion of sugarbeet primary trisomic types into annual and male-sterile condition. Ann. Aula Dei. 16(1-2):141-149.

The sugarbeet primary trisomics recently isolated present three specific problems that make their use in genetic analysis difficult: (1) difficulty

in hand emasculation and artificial hybridization; (2) the presence of the S^f self-fertility allele; and (3) the biennial growth habit. To overcome these problems, systems for the conversion of the isolated trisomic types into annual and Mendelian male-sterile condition, and for the maintenance of the converted series are developed.

RUPPEL, E. G. 1985. Susceptibility of rotation crops to a root rot isolate of Rhizoctonia solani from sugarbeet and survival of the pathogen in crop residues. Plant Dis. (Submitted to journal)

Mean seedling survival in pasteurized soil infested with an AG-2 sugarbeet root-rot isolate of Rhizoctonia solani ranged from 1.3 to 4.7% for highly susceptible barley, bean, corn, red beet, and soybean, and from 20.8 to 56.9% for moderately susceptible muskmelon, sorghum, sugarbeet, and wheat. Pigweed (Amaranthus retroflexus), a common weed in beet fields, had 75% survival. Alfalfa was a nonhost in this study. Isolations from surviving hosts with lesions yielded AG-2 R. solani that caused rot of 2-mo-old sugarbeet roots. Survival of barley, bean, corn, and sorghum plants 2, 4, and 8 wk old at inoculation with low levels of inoculum ranged from 67.5-100%, with a trend toward increased survival with increased age of bean and corn. Of 91 isolates from lesions of surviving barley, bean, corn, and sorghum across all ages, only 16, 41, 53, and 51%, respectively, proved to be R. solani; all but one isolate was in AG-2, and all AG-2 types rotted 2-mo-old sugarbeet roots. Ground residues of infected barley, bean, and sorghum in soil at 20 C yielded AG-2 R. solani after 8 but not 12 wk of incubation; residues of corn yielded the pathogen up to 8 wk. The soil-residue mixtures of bean, corn, and sorghum still were conducive for sugarbeet damping-off after 12 wk, even though the pathogen could not be recovered via soil dilution techniques. No sugarbeet damping-off occurred in the barley residue-soil mix after 12 wk. Results indicate that more than pathogen susceptibility must be considered in selecting cropping sequences to control rhizoctonia root rot in sugarbeet, and that persistence of the pathogen in crop residues may be dependent on the crop species.

SMITH, G. A. 1985. Response of sugarbeet in Europe and the U. S. to Cercospora beticola infection. Agron. J. 77:126-129.

The interaction among cultivars and pathogen races is of particular relevance since sugarbeet (Beta vulgaris L.) cultivars developed in one geographic area may or may not be resistant in other areas. The objective of this study was to investigate the presence of pathological variability among indigenous biotypes of Cercospora beticola under field conditions as measured by cultivar X location (biotype) interaction. Twelve sugarbeet cultivars developed in four different and unrelated breeding programs were evaluated for response to C. beticola in Greece, Italy, Spain, and the U.S.A. The cultivars, representing a wide range of inherent resistance, were evaluated under field epidemics for 3 years. Results indicated that resistance to C. beticola was stable over the four diverse geographic locations and the 3 years, in all probability, in the presence of several different biotypes of the pathogen. If pathogenic races do exist, as has been reported, their presence may be of limited consequence to germplasm development programs.

SMITH, G. A. and H. S. MOSER. 1985. Sporophytic-gametophytic herbicide tolerance in sugarbeet. Theor. Appl. Genet. Approved Sept. 29, 1984

In vitro selection procedures for herbicide tolerance were initially developed in the sporophytic generation of sugarbeet (Beta vulgaris L.), and then tested in the gametophytic generation. The primary objective of our study was to develop and evaluate in vitro techniques for identifying genotypes within heterogeneous seedling populations that were tolerant to specific herbicides, and to use meristematic cloning procedures to synthesize clones genetically tolerant to the herbicide. Seed from cloned selections tolerant to the herbicide ethofumesate were obtained and compared to plants from seed of the original population (using germination, central bud development, and root dry weight). Verification of in vitro selection accuracy was accomplished by pollen germination studies in the gametophyte. The results indicate that in vitro selection of germinated seedlings in the presence of the proper concentration of challenging agent can be effective in identifying genotypes tolerant to ethofumesate. Such identification was accomplished in fully differentiated tissue, but without the necessity of mature plants. Gametophytic studies, via pollen germination, indicated an association between genes operating in the sporophyte and those in the gametophyte. Cloning the seedlings identified as tolerant genotypes and subsequent intercrossing of these clones provided a convenient method of synthesizing populations with gene frequencies shifted in the desired direction.

WILEY, R. B., E. E. SCHWEIZER, and E. G. RUPPEL. 1985. Interaction of Kochia (Kochia scoparia) and Rhizopus sp. on sugarbeet (Beta vulgaris) germination. Weed Sci. (Accepted for publication)

Emergence of sugarbeets (Beta vulgaris L.) 'Mono-Hy D2' from soil was reduced by germinating kochia [Kochia scoparia (L) Schrad. #3 KCHSC] seed at densities greater than 60 seed/60 cm^2 when the fungus Rhizopus sp. was present. Water-soluble exudates from germinated kochia seed did not influence Rhizopus sp. growth in vitro or sugarbeet germination. Cell-free culture extracts of Rhizopus sp. reduced sugarbeet germination and radicle elongation.

GAMETOPHYTE-SPOROPHYTE COMPLEMENTATION AND POLLEN TECHNOLOGY TO ASSESS AND SELECT FOR ECONOMIC CHARACTERS
(BSDF Project 76)

The objective of this project is, as the title implies, to determine if gametophyte-sporophyte complementation occurs and is related to sporophytic hybrid vigor. Other objectives of this project are the development of technologies necessary to use pollen to assess and select for various economic characters. The succeeding sections of this report are reports of progress and preliminary results.

Relation of Hybrid Vigor and Gametophyte-Sporophyte Complementation--R. J. Hecker.

In response to my request, the sugarbeet breeders of several BSDF member

companies have provided me half-sib pairs of hybrids that were distinctly different in root yield, this difference resulting from the relative amount of hybrid vigor expressed in the progeny of a male sterile when pollinated by two different pollinators. The hypothesis being tested in experiments of this project is that the degree of genetic complementation expressed as sporophytic hybrid vigor can be detected and measured by complementation that occurs between the pollen (gametophyte) and the stylar tissue (sporophyte) in which the pollen tube is growing. If the hypothesis is true, the female and male combination that gave rise to the high yielding half-sib hybrid should have the most rapid growth of the pollen tube in the stylar tissue, and pollen from that male should effect fertilization more frequently than pollen from the male that produced the low yield half-sib hybrid.

The first step in the experimentation was to field test the 16 pairs of half-sib hybrids that had been assembled. These yield comparisons from one year of testing are shown in Table 1. Only five of the 16 half-sib pairs had significantly different root yields, hybrid pairs 6, 8, 9, 11 and 14. This is not surprising because in all likelihood the low yielding hybrids of these half-sib pairs had been tested previously for only one year. It is likely that low yielding hybrids would have been dropped from further testing. These hybrids will be field tested a second year for root yield, along with any additional low and high yield half-sib hybrid pairs that I may be able to find.

To test for gametophyte-sporophyte complementation, controlled pollinations were achieved with the parents of half-sib hybrid pairs 1 through 13. About 10 plants of the CMS female used in each pair of hybrids was hand-pollinated by a 1:1 mixture of pollen collected from about 20 plants of each of the two males. These types of pollinations were continued until the pollen supply was exhausted or there were no remaining receptive female flowers. Each female plant was usually pollinated two to eight times. In order to identify the two types of hybrids among these progenies the CMS plants used were always green hypocotyl, while one of the males was pink hypocotyl and the other was green. In the hybrid progeny from these mixed pollinations the frequency of fertilization by each of the two males could then be determined. In Table 1 the expected genotypic frequencies would have arisen from equal rates of fertilization by the two males. The obtained frequencies of the marker genotypes were those hypocotyl colors actually obtained in the progenies from the mixed pollinations. The last column in the table is an index of any complementation between the pollinator of the high yield half-sib hybrid and the CMS, relative to the pollinator that produced the low yield hybrid. Hence, in hybrid pair 1, the pollinator of hybrid 971 succeeded in fertilizing the male sterile 12.2% more often than did the pollinator in hybrid 970. This index of .122 is positive because this positive deviation from expected frequency was by the pollinator that had produced the more vigorous hybrid (971). The only meaningful comparisons of this nature that should be made are those in which there were significant yield differences between half-sib hybrids, hybrid pairs 6, 8, 9, 11, and 14. Since the controlled pollinations to produce hybrids 14, 15, and 16 have not been completed as yet, hybrid 14 must be dropped from consideration. Among the four remaining pairs (6, 8, 9, and 11), 6, 9, and 11 have positive complementation indices while 8 has a negative complementation index. Hence, there is no real trend in these very preliminary data. However, there are several conditions that could be confounding these results, namely, (1) the accuracy of the root yield test in

Table 1. Root yield (kg/6.6 m plot) of pairs of half-sib hybrids that were expected to be low and high yield pairs from previous field tests.

Half-sib hybrid pair	Hyb. entry no.	Root yield	% the high hyb. exceeded low hyb.	Genotype freq. in controlled pollinations				Sporo-gameto. compl. index
				Expected		Obtained		
				rr	R-	rr	Rr	
1	970 971	30.91 32.43	5	.597	.403	.475	.525	+.122
2	972 973	36.89 38.17	3	.635	.365	.630	.370	-.005
3	974 975	41.02 39.49	4	.5	.5	.604	.396	-.104
4	976 977	37.71 38.93	3	.5	.5	.560	.440	+.060
5	978 979	38.43 38.66	1	.49	.51	.615	.385	-.125
6	980 981	41.70 39.41	6*	.5	.5	.024	.976	+.476
7	982 983	34.34 33.61	2	.5	.5	.276	.724	-.224
8	984 985	32.91 29.27	12*	.5	.5	.300	.700	-.200
9	986 987	32.90 36.35	10*	.5	.5	.468	.532	+.032
10	988 989	32.65 32.78	1	.5	.5	.380	.620	+.120
11	990 991	38.83 43.30	12*	.5	.5	.453	.547	+.047
12	992 993	45.11 46.51	3	.677	.323	.529	.471	-.148
13	994 995	44.00 43.12	2	.573	.427	.459	.541	-.114
14	996 997	43.18 38.14	13*	-	-	-	-	
15	998 999	36.30 37.43	3	-	-	-	-	
16	1000 1001	36.57 38.00	4	-	-	-	-	

*Half-sib hybrids were significantly different (P = .05)

the field, and (2) lack of pollen viability information from which to mix appropriate quantities of pollen from the two males in each half-sib hybrid pair.

Controlled pollinations of the 16 half-sib pairs are in the process of being repeated, with the pollen from each of the two males in every case being tested for viability with fluorescein diacetate (FDA). This new pollen staining technique is described in a subsequent section of this Project. Pollen viability stains and in vitro germination tests of pollen in the first phase of this experiment indicated that there were differences in pollen viability from plant to plant and day to day, so that 1:1 pollen mixtures probably did not contain the same number of viable pollen from each of the two males in the mixed pollinations that we used. The experiments done in this preliminary phase will be conducted again in this modified and somewhat expanded form. Also tested will be other ideas to detect the presence of other types of complementation between different genotypes that might correlate with the type of genetic complementation that results in hybrid vigor.

Use of Gametophytic Generation (Pollen) for Selection and Assessment--R. J. Hecker.

Pollen biology is a topic that long has been of interest to those studying pollination, fertilization, and, especially, incompatibility. In recent years there has been a renewed interest in pollen as an organism somewhat independent of the sporophytic generation. In the past, it has been generally held that the same genes are not active in the gametophytic and sporophytic generations. However, it has become apparent recently that many sporophytic characteristics may be expressed in the gametophytic generation. It has been reported that about 60% of the structural genes coding for certain enzymes in the tomato sporophyte also are expressed in the gametophyte. Another recent study found that about 60% of the mRNA in pollen also is present in somatic tissue. These findings indicate that it may be possible to assess or even select in the gametophyte for genes expressed in both generations. Selection in the haploid gametophyte theoretically should be much more effective than selection in the diploid sporophyte. There has been no significant practical application of gametophytic selection in plants until recently when selection in tomato for low temperature tolerance was made during the fertilization process. This may be the first time in higher plants that alteration of an environmental factor has been demonstrated to change selection values of male gametophytes in a manner predicted from the ecology of the parental sporophytes.

The potential utilization of this recent knowledge by sugarbeet scientists requires the development of consistent and accurate methods of sugarbeet pollen germination, tube growth, and viability assessment. Although considerable research has been done on quality assessment on sugarbeet pollen, methods that consistently and reliably assess functional quality of sugarbeet pollen have never been reported. The sugarbeet is among those plants that produce trinucleate pollen, which is generally difficult to germinate in vitro and is highly vulnerable to environmental stresses.

In response to a need generated in our gametophyte-sporophyte complementation research, we have commenced research on vital stains of

sugarbeet pollen and all aspects of in vitro pollen germination.

Although successful fertilization as measured by seed set depends on numerous complicating post-pollination factors, an ideal test of pollen quality should be simple, rapid, and should determine the frequency of pollen capable of conveying the two male gametes into the embryo sac. Any test falling short of this is less than ideal. A rapid vital stain that would measure this viability would be an ideal test, since it is usually necessary to know the viability of a particular pollen collection prior to challenging or exposing the pollen to some treatment or stress factor. Stainability tests of different types variously stain different cell contents, but usually do not necessarily assess pollen viability. The fluorochromatic reaction tests (a) for the presence of an active esterase and (b) for plasmalemma integrity within the pollen. The fluorescein diacetate (FDA) reaction in pollen, as reported in the literature, appears to be highly correlated with pollen germinability in vitro for several genera in several families. FDA, a non-polar molecule, is able to pass through the intact plasmalemma of pollen where esterases hydrolyse the ester bond of the acetate moiety, converting the fluorescein into a polar molecule that is unable to pass out through the plasmalemma. The resulting buildup of fluorescein results in fluorescence under proper illumination, and can occur only when the pollen has active esterase enzymes and intact plasmalemma. These are conditions necessary for pollen viability.

As mentioned earlier, trinucleate sugarbeet pollen is very vulnerable to environmental stresses and has a relatively short post-dehiscence life. Conditions for collection and handling of pollen for various pollen experiments are somewhat critical. One of the most critical conditions appears to be post-dehiscence exposure to low humidity. We have found that the best pollen collected from plants grown in the greenhouse occurs when the plants are blown one evening to remove pollen, and then pollen collection is made the next day. Rapid collection and handling of pollen is essential since pollen viability deteriorates very rapidly in the low humidity of greenhouse and lab. In Table 1 pollen exposed on a watch glass in the lab at about 22°C for 45 minutes lost essentially all of its fluorescence. The greatest amount of pollen fluoresced when fresh pollen was hydrated for as little as 5 minutes in a closed saturated environment at 22°. The ability of pollen to fluoresce was recovered when pollen exposed in the lab for 45 minutes was then hydrated for 5 minutes. Recovery decreased with increasing exposure time until more than eight hours of exposure after which fluorescence was not recovered by hydration. Our procedure for making the FDA stain is the addition of one or two drops of FDA stock solution (2 mg FDA/1 ml acetone) to a quantity of Brewbaker and Kwack pollen germination medium so that the final concentration of FDA in the medium is about 0.01%. The B & K standard stock solution of salts is brought to 32% sucrose and pH adjusted to 5.0.

We have done considerable work on techniques of in vitro pollen germination. Table 2 summarizes the optimum conditions for in vitro pollen germination that we have determined in our research. In the medium preparation process the sucrose concentration and pH are relatively critical. Pollen density is a critical factor, as has been reported in various other species. We do not have an explanation for this pollen density effect at this time. Pollen collection and handling should be expeditious because a loss of pollen viability is directly related to time of exposure to a low humidity

laboratory environment. Uniform pollen hydration or humidification immediately prior to putting the pollen into the liquid germination medium is a critical factor. Our standard procedure is to add 1.4 mg of pollen to 4.5 ml of germination medium in a 5.5 cm petri dish. Germination proceeds on the laboratory bench for at least 6 hours. Counts of germinated pollen are then made directly in each petri dish with a microscope using bright field illumination.

A comparison of in vitro pollen germination on liquid and solid media with FDA and tetrazolium bromide (TZB) stains is made in Table 3. The 12 different pollen lots varied in viability from 14 to 53% when germinated on liquid medium. The percentage of pollen stained with FDA ranged from 44 to 95%. The correlations among the four viability testers within these 12 separate tests were as follows; liquid vs solid medium = .34, liquid vs FDA = .51, liquid vs TZB = .41, solid vs FDA = .19, solid vs TZB = .16, and FDA vs TZB = .80. The only significant correlation is FDA vs TZB. The correlation of germination on liquid medium vs FDA at .51 has a P value of 0.09.

The relationship between these viability testers is quite low in these preliminary experiments. In a separate small experiment that included only FDA and TZB stains and germination on liquid medium, the relationship between the three testers appeared to be better. More of these types of experiments will be conducted with more rigid control of pollen collection handling in other procedures, since variability due to extraneous sources is so influential on staining and germination. This viability testing will be continued because a vital need in pollen assessment research is a quick and relatively simple viability test that measures the true capability of pollen to convey the two male gametes into the embryo sac and effect fertilization. This next phase of testing will involve the viability measures in Table 3 as well as in vivo germination and frequency of actual fertilization and embryo development.

Table 1. FDA stained sugarbeet pollen.

Pollen treatment	% fluorescing pollen		
	Source 1	Source 2	$\bar{x}$
Fresh pollen	58	38	48
Fresh pollen, hydrated 5 min	66	76	71
Pollen exposed in lab 45 min	4	1	2
Exposed 45 min, hydrated 5 min	50	55	52

Table 2. In vitro pollen germination, optimum conditions.

1. Liquid medium; solid (agar) medium is not as good as liquid

2. Medium stock solution; 10 ml distilled H_2O:1 mg H_3BO_3:
   3 mg $[Ca(NO_3)_2 \cdot 4H_2O]$:2mg $(Mg\ SO_4 \cdot 7H_2O)$:
   1 mg KNO_3 (can keep stock refrigerated)

3. Sucrose; 32% (32 g sucrose brought up to 100 ml with stock solution; do not store)

4. pH; 5.0 (after mixing suc. and stock; do not store)

5. Light; not critical

6. Pollen density; 8 mg pollen/13.5 ml medium (4 mg is satisfactory if pollen is scarce)

7. Pollen collection; shaken from flowers onto glass plate, pollen separated from foreign matter; rapid handling is critical

8. Pollen hydration; enclose in small 100% humidity environment for 5 min

9. Time and temperature; 6 hrs at 23°C.

Table 3. In vitro sugarbeet pollen germination and vital staining.

Pollen source & collection date	% germinated in vitro		% stained	
	Liquid med.	Solid med.	FDA	TZB
A 11-7-84	14	15	67	75
B 11-7-84	19	11	91	82
E 11-16-84	21	6	86	91
C 11-16-84	30	12	68	83
D 12-4-84	31	11	58	64
D 12-11-84	17	3	73	83
E 12-19-84	53	2	90	93
F 12-19-84	35	4	87	76
G 12-19-84	43	5	95	84
H 12-19-84	28	5	73	75
C 12-18-84	17	7	44	64
H 12-18-84	35	15	91	90
Mean	29	8	77	80

Cryogenic Storage of Sugarbeet Pollen--R. J. Hecker.

Storage of sugarbeet pollen has two potentially valuable uses, (1) as a tool for plant breeders and geneticists to accomplish desired hybridizations and (2) as a means of long term sugarbeet germplasm preservation. We conducted experiments in 1984 on cryogenic storage (liquid nitrogen) of sugarbeet pollen compared with other storage environments. The results of one experiment is shown in Table 1. The pollen was collected 7-13-83 from field plots. The pollen was desiccated 24 hours to remove freezable water, a requirement for cryogenic storage, then the pollen was stored. Pollen moisture was reduced from about 25% to about 6%. About 12% was the point below which freezable water was not present, as determined by differential thermal analysis. Upon removal of pollen from storage, moisture was determined, tetrazolium bromide (TZB) stain counts were made, pollen was germinated on B & K solid medium, and receptive CMS plants were pollinated. The results are in Table 1. These preliminary results indicate that pollen survived cryogenic storage (-196°) and -18° for 1 year, and that a significant portion of the pollen was functional at the end of the storage period. Further experiments are in process with some modifications, based on results of our other pollen research. In these experiments we are rehydrating the pollen after removal from storage and before testing the pollen viability, substituting fluorescein diacetate for tetrazolium bromide as a vital stain, and germinating pollen in liquid medium.

Our demonstration of successful long term cryogenic preservation of sugarbeet pollen indicates that male gametes can be preserved indefinitely. This can be a valuable technology for geneticists and breeders. Even more important is the potential for germplasm preservation. Any genotype could be preserved indefinitely, then by backcrossing, the exact nuclear genotype could be recovered.

Table 1. Viability of stored sugarbeet pollen.

Pollen treatment	Pollen moisture (%)	TZB stained pollen (%)	In vitro pollen germ. (%)	Seed germination (%)
Desiccated 24 hrs	6.8	46	0.8	28
Stored 24 hrs				
5°C	8.0	82	11.2	40
-18°	6.7	43	8.4	30
-196°	6.1	72	22.7	42
Stored 26 days				
5°C	6.7	72	2.3	89
-18°	4.4	75	10.0	98
-196°	3.8	80	5.0	47
Stored 1 yr				
5°C	6.0	0	0	0*
-18°	7.1	68	1.4	NA**
-196°	4.3	83	8.7	NA**

*=No seed was formed.
**=Data not yet available, however, viable appearing seed was formed after pollination with the -18° and -196° stored pollen.

IN VITRO SELECTION AND REGENERATION OF ELITE SUGARBEET GENOTYPES

(BSDF Project 75)

G. A. Smith

The original objectives of this project were to investigate and develop tissue culture techniques for proliferation of elite sugarbeet genotypes and to study and develop in vitro screening techniques effective in identification of herbicide tolerant genotypes.

Although further refinement is warranted, both of these objectives have been realized and consequently expanded objectives built upon these results have been developed.

Brief Summary of Results and Plans

We can now routinely multiply and root most genotypes in vitro which allows the establishment of clonal lines useful for many purposes. This multiplication and rooting can be achieved from axillary or terminal buds of flowering plants or from in vitro germinated seed and in the near future from callus tissue. The development of the methods and procedures for the selection or screening of elite genotypes has been successful in isolating

herbicide tolerant genotypes. The tolerant genotypes have been isolated from seedling populations grown in vitro in media containing appropriate concentrations of a challenging agent. Use of the pre-emergence water soluble herbicide Nortron (ethofumesate) as the challenging agent has enabled us to develop a model system which we believe can be used in both the sporophytic and gametophytic generations.

Our objective is to develop in vitro screening techniques using the pathotoxins such as cercosporin as challenging agents. Based on the hypothesis of correlated responses of genes active on the gametophytic and sporophytic generations, we will include both generations in our research. Dr. S. S. Martin of our research group has isolated and purified cercosporin in crystalline form. Cercosporin is primarily soluble in lipid or organic solvents. However, from pure crystals, we have prepared a saturated aqueous solution. Although the solubility is extremely low, we have been able to measure it with a new diode array spectrophotometer. This cercosporin solution was tested in the gametophytic generation and found to be highly inhibitory to pollen germination. In addition, dilute alcohol solutions of cercosporin were tested on sporophytic generation tissue from cercospora resistant and susceptible lines. The results enabled us to differentiate between the lines (see project 91 in this report). Our near term plans are to use the model system from our herbicide research with the pathotoxins (initially with cercosporin).

Representative Results

Results from progeny of several clones selected in vitro in the sporophytic generation are presented in Figures 1 and 2. Central bud development is presented because ethofumesate typically inhibits development at the growing point and thus in our studies, central bud development was used as a principal selection criteria. Results presented are from replicated greenhouse tests in which seed from intercrossed clones of selected seedlings were grown in soil treated with a range of ethofumesate concentrations. Original seedling population screening was on media containing 12 mg/kg (12 ppm) which is four times the normally recommended field level for the herbicide. Results from the gametophytic generation for specific clones which had been originally screened and selected for herbicide tolerance in the sporophytic generation are presented in Figure 3. Pollen was collected from these selected clones and then cultured in liquid media containing 10 or 20 mg/L ethofumesate. In the majority of cases, cloned seedlings showing tolerance in the sporophyte also showed significant tolerance in the gametophyte. Infrequently, a clone selected as tolerant in the sporophyte does not reflect significant tolerance in the gametophyte. Clone N 15-2 is an example of such a clone (Figure 3). In the absence of a better explanation, we must conclude that an errant selection was made in the sporophyte. The potential for an errant selection in the sporophyte underlines the significance of a system which allows verification in the gametophyte. Of course, such a system may suggest selection in the gametophyte - a possibility we are investigating.

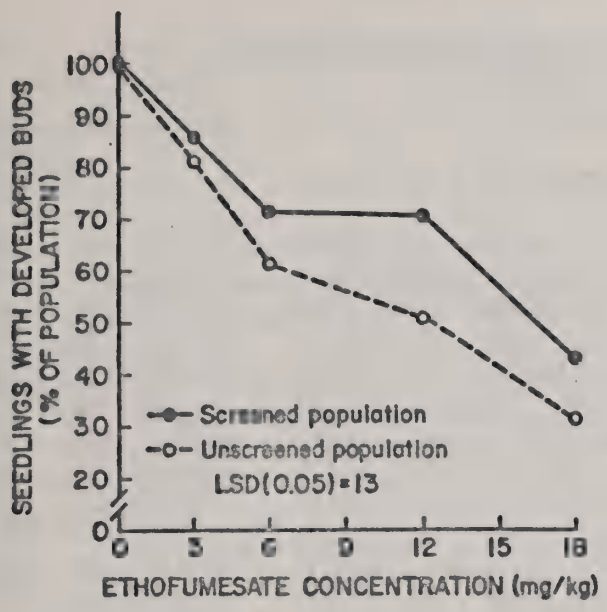

Figure 1. Central bud development of seedling progeny from screened and original population under various concentrations of ethofumesate.

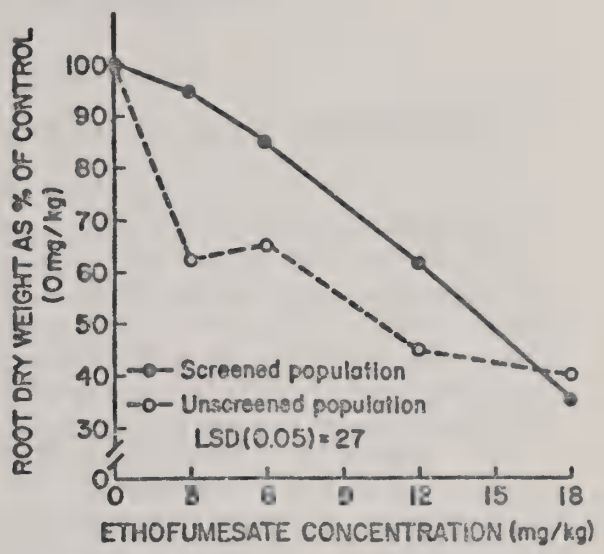

Figure 2. Root dry weight of seedling progeny from screened and original population under various concentrations of ethofumesate.

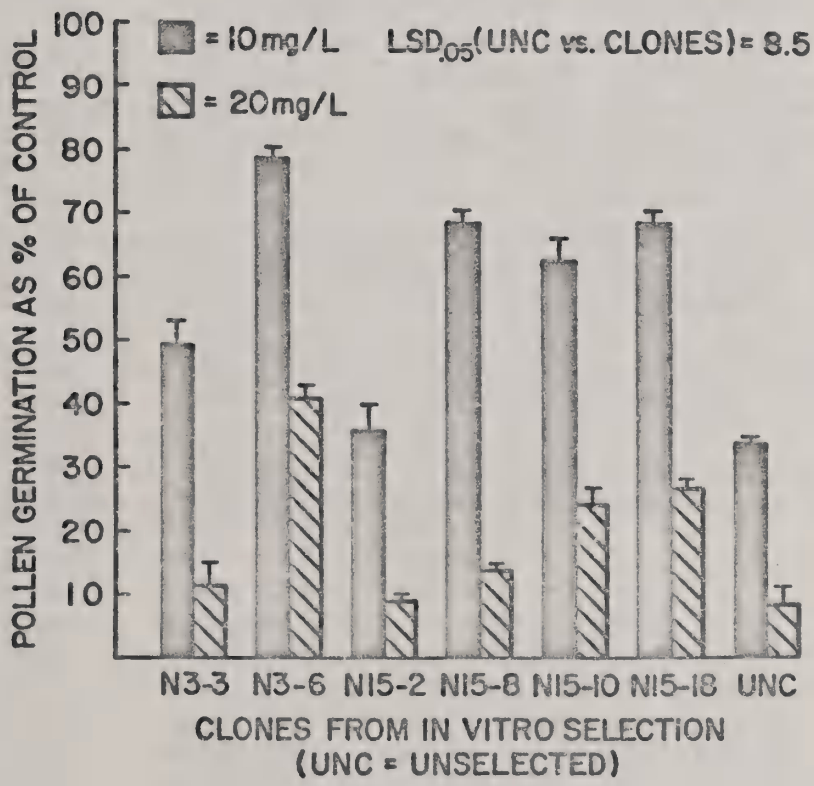

Figure 3. Germination of pollen from each of seven clones cultured in media containing 10 and 20 mg/L ethofumesate. Values for each clone are given as percent of that clones control. One SE shown at top of each bar.

CERCOSPORA/CURLY TOP RESISTANCE BREEDING AND RELATED RESEARCH
(BSDF Project 25)

1984 Cercospora Field Research--G. A. Smith and E. G. Ruppel

The 1984 Cercospora field research supported by BSDF project 25 was conducted for the third year on Colorado State University land located just west of the CSU veterinary research and teaching center. The leaf spot nursery was planted April 18. Planting was followed by rain and heavy wet snow on April 20, and by heavy frost on April 29. Although soil temperatures remained cold for an extended period of time, final stands were good. The nursery was inoculated on July 5 and July 12. Conditions for development of leaf spot were unusually good throughout the summer. The epiphytotic peaked about August 23. Evaluations for all tests in the nursery were conducted on August 16 and 23. On August 23, the mean nursery ratings of all the susceptible and resistant checks were 7.2 and 3.8, respectively. These values compare with 6.9 and 4.8 for susceptible and resistant checks, respectively, in 1983.

Breeding for Resistance to Cercospora and Curly Top Virus 1984--G. A. Smith and E. G. Ruppel

The leaf spot epidemic in our 1984 nursery was moderately severe and uniform. The leaf spot resistant check in the breeding nursery (entry 1589) averaged 3.3, and the susceptible check (entry 1591) averaged 6.5. The curly top epidemic in Idaho was only moderate. U.S. 41 averaged 3.8 and the susceptible U.S. 33 averaged 4.5, respectively, compared with 3.5 and 5.8 for the 1983 nursery. Only selected entries from the Ft. Collins breeding program were tested for curly top resistance in Kimberly, Idaho. For 1984, 50 entries were evaluated at the Idaho nursery.

The results from our breeding nursery tests for 1984 are presented in Table 1. Fifty six of the breeding lines equaled or exceeded the Cercospora resistance of the long term checks, and the majority of entries sent to Idaho were more resistant to curly top than the resistant check. Entries 1579 through 1587 were accessions from China that we had increased. Two of these entries showed better than average leaf spot resistance (entries 1579 and 1581). Entries 1575 and 1576 were evaluated for leaf spot resistance in the C_3 generation, and are now being advanced to the C_4 generation. The triploid equivalent of FC 607 was among the most resistant entries in the nursery (entry 1577).

Table 1. Mean leaf spot and curly top ratings of some breeding lines and other entries at Ft. Collins, CO, and Kimberly, ID, 1984.

Entry no.	Seed no.	Description	Leaf Spot[1]	Curly top[1]
1462	821036H02	(662119s1 CMS X 562) X FC607 T.O.	4.0	3.0
1463	821036H03	502/3 CMS X FC607 T.O.	3.3	
1464	821036H04	1861 CMS X FC607 T.O.	5.8	
1465	821036H05	721055 CMS good C.A. for CTR X FC607 T.O.	3.5	3.0
1466	821036H07	FC504 CMS X FC607 T.O.	3.0	4.0
1467	821036H08	662119s1 CMS X FC607 T.O.	3.8	3.5
1468	821039H05	(FC504 CMS X FC502/2) X FC606 T.O.	3.5	
1469	821039H06	FC506 CMS X FC606 T.O.	3.0	4.0
1470	821039H07	721055 CMS good C.A. for CTR X FC606 T.O.	4.0	4.0
1471	821041H02	FC605 CMS X FC502/3 T.O.	2.5	
1472	821041H01	FC502/3 CMS X FC502/3 T.O.	2.8	
1473	821041H06	FC506 CMS X FC502/3 T.O.	2.5	
1474	821045H02	(FC605 CMS X FC502/3 T.O.) X 721055 T.O.	5.0	3.5
1475	821050H02	(622112s1 CMS X 662119s1 T.O.) X SP6322-0 MM	3.8	
1476	821050H05	FC607 CMS X SP6322-0 MM	3.8	
1477	821050H06	721055 CMS good C.A. for CTR X SP6322-0 MM	3.5	
1478	821050H07	FC504 CMS X SP6322-0 MM	4.0	
1479	821050H08	662119s1 CMS X SP6322-0 MM	3.5	
1480	821054H3	721055 CMS good C.A. for CTR X Spanish LS "Tolerant" line 4x	4.0	
1481	821054H4	662119s1 CMS X Spanish LS "Tolerant" line 4x	4.0	
1482	821056H3	FC504 CMS X Spanish LS "Tolerant" line 4x	3.8	
1483	821057H3	FC504 CMS X Spanish LS "Tolerant" line 4x	3.5	
1484	821058H3	662119s1 CMS X Spanish LS "Tolerant" line 4x	3.3	
1485	821059H2	(FC504 CMS X FC502/2) X Aula Dei 645 (4x) LSR	3.8	
1486	821059H3	662119s1 CMS X Aula Dei 645(4x) LSR	3.5	
1487	821061H3	(622112s1 CMS X 662119s1 T.O.) X HSI 501,4x,MM	5.5	
1488	821062H2	FC605 CMS X HSI 101,4x,MM	5.8	
1489	811001H08	(652016s1 CMS X FC605) X FC708 T.O.	4.5	
1490	811002H05	652016s1 CMS X FC708 T.O.	4.3	
1491	811003H02	662119s1 CMS X FC607 T.O.	3.8	
1492	811004H04	FC606 CMS X SP 74564-0 T.O.,mm	3.5	
1493	811006H02	FC607 CMS X FC608 T.O.	3.5	
1494	811006H03	FC506 CMS X FC608 T.O.	3.8	
1495	811008H2	FC607 CMS X SP 6322-0, MM	3.5	
1496	811008H4	662119s1 CMS X SP 6322-0, MM	3.8	
1497	811008H5	FC608 CMS X SP 6322-0, MM	3.8	
1498	811008H7	(662119s1 CMS X FC605)X SP 6322-0,MM	4.0	
1499	811008H9	(1861 CMS X FC605)X SP 6322-0,MM	4.0	
1500	811009H4	(FC605CMS X FC502/3 T.O.)X SP6322-0,MM	3.0	
1501	811009H6	(652016s1 CMS X 662119s1 T.O.) X SP6322-0 MM	4.3	
1502	811010H2	FC607 CMS X 761016 H MM non-T.O.	3.8	
1503	811011H02	FC506 CMS X 761036 HO mm,662110s1 T.O.	3.5	
1504	811011H04	(662119s1 CMS X FC605 T.O.) X 761036 HO mm, 662110s1, T.O.	3.5	3.0

Table 1. Mean leaf spot and curly top ratings . . . continued

Entry no.	Seed no.	Description	Leaf spot[1]	Curly top[1]
1505	811011H05	(FC603 CMS X FC605 T.O.) X 761036 HO mm, 662110s1 T.O.	4.8	
1506	811012H02	(652016s1 CMS X FC605) X 761036 HO mm, 662110s1 T.O.	4.0	3.5
1507	811012H03	FC(605 CMS X 502/2 T.O.) X 761036 HO mm,662110s1 T.O.	3.5	
1508	811012H07	FC502/3 CMS X 761036 HO mm, 662110s1 T.O.	3.0	
1509	811012H08	(1861 CMS X FC606 T.O.) X 761036 HO mm, 662110s1 T.O.	5.0	
1510	811015H02	662119s1 CMS X FC605 T.O.	3.5	
1511	811015H03	(622112s1 CMS X 662119s1 T.O.) X FC 605 T.O.	4.0	3.5
1512	811025H3	(FC605 CMS X 1861 T.O.) X Spanish LS "Tolerant" line 4x,740002	3.8	
1513	811027H2	FC606 CMS X Spanish LS "Tolerant" line 4x,740010	3.8	
1514	811027H3	(FC605 CMS X 1861 T.O.) X Spanish LS "Tolerant" line,4x,740010	3.8	
1515	811028H3	(632028s1 CMS X FC605 T.O.) X Spanish LS "Tolerant" line 4x, 740004	3.5	
1516	811028H4	(FC605 CMS X 1861 T.O.) X Spanish LS "Tolerant" line 4x, 740004	3.0	
1517	811029H3	(FC605 CMS X 1861 T.O.) Spanish LSR,645,4x,740480	4.3	
1518	811031H	Aula Dei 645(4x) LSR	3.8	
1519	821034H01	FC606 CMS 4x, C_2	4.0	
1520	821097H0	FC607 T.O. 4x	3.3	
1521	821097H01	FC607 CMS 4x	3.0	
1522	801123H0	FC607 T.O. Reselected	3.8	
1523	A78-44	FC606 T.O. (official release)	3.5	
1524	A78-45	FC606 CMS (official release)	3.5	
1525	A79-67	FC607 T.O. (official release)	3.5	
1526	A79-68	FC607 CMS (official release)	3.5	
1527	A81-62	Mono Hy E4	3.8	
1528	801096H02	FC608 CMS X 761036 HO from 662110s1	4.3	
1529	801096H06	(642027s1 CMS X 662119s1 T.O.) X 761036 HO,mm from 662110s1 LSR-CTR	4.5	
1530	801096H08	FC506 CMS X 761036 HO mm from 662110s1 LSR-CTR	4.3	
1531	791013H03	FC502/3 CMS X FC605 T.O. mm	3.3	
1532	791013H04	662119s1 CMS X FC605 T.O. mm	3.3	3.0
1533	791015H02	FC605 CMS X FC502/2 T.O.	2.8	
1534	791015H04	(652016s1 CMS X FC605) X FC502/2 T.O.	3.0	
1535	791016H03	FC606 CMS X FC502/3 T.O.	3.3	
1536	791019H04	FC502/2 CMS X 661153 HO; 642027s1=FC603 T.O.	2.8	
1537	791019H06	(652016s1 CMS X FC605) X 661153 HO; 642027s1=FC603 T.O.	3.5	
1538	791024H02	FC502/2 CMS X 622027s1, 642010s1 T.O.	3.0	
1539	771077	US 201 LSR,MM	3.8	
1540	751102H05	FC506 CMS X FC605 T.O.	3.3	

Table 1. Mean leaf spot and curly top ratings . . . continued

Entry no.	Seed no.	Description	Leaf spot[1]	Curly top[1]
1541	831026H02	FC 607 CMS X 662119s1 T.O.	3.8	
1542	831026H03	FC 607 CMS (selected) X 662119s1 T.O.	4.3	2.5
1543	831026H04	761036H01 CMS (B_3) X 662119s1 T.O.	3.8	
1544	831026H05	FC 504 CMS X FC 502/2 T.O. X 662119s1 T.O.	3.8	3.0
1545	831028H02	662119s1 CMS X FC 506 T.O.	4.3	2.5
1546	831028H03	FC 607 CMS X FC 506 T.O.	4.3	3.5
1547	831028H04	FC 607 CMS (sel) X FC 506 T.O.	3.3	3.5
1548	831028H05	FC 606 CMS X FC 506 T.O.	4.0	2.5
1549	831028H06	761036H01 CMS (B_3) X FC 506 T.O.	3.8	
1550	831028H07	652016s1 CMS X FC 506 T.O.	4.5	
1551	831029H02	662119s1 CMS X FC 607 T.O.	3.5	3.0
1552	831029H03	761036H01 CMS (B_3) X FC 607 T.O.	3.8	
1553	831029H04	(6520L6Ss1 CMS X 662119s1. T.O.) X FC 607 T.O.	3.3	3.5
1554	831030H02	662119s1 CMS X FC 607 T.O.	3.8	3.5
1555	831030H03	(FC 605 CMS X FC 502/2 T.O.) X FC 607 T.O.	3.3	4.0
1556	831030H04	761025H01 CMS (B_3) X FC 607 T.O.	3.3	3.5
1557	831030H05	FC 605 CMS X FC 607 T.O.	3.0	3.5
1558	831031H02	FC 607 CMS X FC 708 T.O. mm	3.8	3.5
1559	831031H03	(FC 605 CMS X 761036H0) X FC 708 T.O. mm	3.8	4.0
1560	831031H04	(FC 606 CMS X FC 502/2 T.O.)X FC 708 T.O. mm	3.5	4.5
1561	831032H02	662119s1 CMS X FC 606 T.O.	3.8	3.5
1562	831032H03	(FC 605 CMS X FC 502/2 T.O.) X FC 606 T.O.	3.3	3.5
1563	831032H04	761036H01 CMS (B_3) X FC 606 T.O.	3.8	3.5
1564	831033H02	FC 607 CMS X 761036 HO mm	4.3	3.5
1565	831033H03	FC 605 CMS X 761036 HO mm	3.3	
1566	831033H04	(FC 606 CMS X 502/2 T.O.) X 761036 HO mm	3.8	3.5
1567	831034H2	(FC 605 CMS X 502/2 T.O.) X SP6322-0 MM	3.3	
1568	831034H3	(FC 605 CMS X 761036 HO) X SP6322-0 MM	3.3	
1569	831034H4	761036H01 CMS (B_3) X SP6322-0 MM	3.5	5.0
1570	831034H5	(FC 504 CMS X FC 502/2 T.O.) X SP6322-0 MM	3.8	
1571	831034H6	(652016s1 CMS X 662119s1 T.O.) X SP6322-0 MM	4.0	
1572	831034H7	(FC 606 CMS X FC 502/2 T.O.) X SP6322-0 MM	3.0	
1573	831038H02	FC 607 CMS (sel.) X FC 502/3 T.O.	3.0	3.5
1574	831038H03	FC 605 CMS X FC 502/3 T.O.	3.3	
1575	831040H0	FC 606 T.O. 4x, C_3	4.0	
1576	831042H01	FC 607 CMS 4x, (C_3)	3.3	
1577	831042H02	FC 607 CMS 2x X FC 607 T.O. 4x(C_2)	2.8	
1578	831044	FC 901 MM, LSR	5.3	
1579	831045	Chinese Acc. PI 467869	3.8	
1580	831046	Chinese Acc. PI 467870	5.5	
1581	831047	Chinese Acc. PI 467871	3.5	
1582	831048	Chinese Acc. PI 467874	5.0	
1583	831049	Chinese Acc. PI 467875	4.5	
1584	831050	Chinese Acc. PI 467876	4.8	
1585	831051	Chinese Acc. PI 467877	4.0	
1586	831052	Chinese Acc. PI 467878	5.0	
1587	831053	Chinese Acc. PI 467879	5.3	

Table 1. Mean leaf spot and curly top ratings . . . continued

Entry no.	Seed no.	Description	Leaf spot[1]	Curly top[1]
1588	761042H2	LSR check, FC(504 X 502/2) X SP6322-0	3.5	
1589	821051H2	LSR check, FC(504 X 502/2) X SP6322-0	3.3	
1590	A63-5	ILSR check, SP5822-0	3.0	
1591	771056H	LSS check, Synthetic check	6.5	
	US 41	CTR check	-	3.84
	US 33	CTS check	-	4.54
	LSD .05		.94	

[1]Leaf spot and curly top ratings based on 0-10 scale, with 0 = no symptoms and 10 = dead for curly top or complete defoliation for leaf spot.

Leaf Spot Evaluations of Sugarbeet Lines Submitted by BSDF-Member Companies.--E. G. Ruppel and G. A. Smith.

Separate randomized complete block designs with two replicates were used to evaluate a total of 201 lines submitted by six BSDF-member companies for resistance to Cercospora beticola. Internal controls included a highly susceptible synthetic, and leaf spot resistant FC (504 X 502/2) X SP 6322-0. Two-row plots were 4 m long with 56 cm between rows. We inoculated twice (July 5 and 12), and evaluations were made on August 16 and 23. On August 23, the mean ratings (scale of 0 to 10) of the resistant and susceptible controls were 3.8 and 7.2, respectively, across all tests. Means of contributed lines ranged from 3.0 to 7.8. Results of the individual tests were tabulated, statistically analyzed, and sent to each respective contributor.

Interplot Interference in Field Evaluations for Cercospora Leaf Spot Resistance.--E. G. Ruppel.

Interplot interference is a potential factor that must be considered in small field-plot experiments, especially those involving sporulating foliar pathogens and evaluations of treatment effects or quantitative genetic resistance of the host. Evaluations of relative resistance of test cultivars, or of the relative efficacy of control measures can be erroneous if significant interplot interference occurs (J. E. Vanderplank, 1963, Plant Diseases: Epidemics and Control, Academic Press, NY).

In our annual leaf spot nursery, a resistant control line is randomly included in all tests. If interplot interference is a factor, one would expect the resistant line to have higher disease intensity in tests where mostly highly susceptible lines would continually bombard the resistant check. Conversely, the same check line in tests where most of the entries were resistant should have lower disease ratings, because exposure to inoculum is considerably reduced. With significant interplot interference, lines

submitted for evaluation by cooperators (which usually are more susceptible than more advanced lines) might be judged too harshly, and important germplasm could be rejected.

To determine whether interplot interference occurred in our leaf spot nurseries, the mean disease ratings of resistant FC(504 X 502/2) X SP 6322-0 were compared between contributor tests and an annual test of our most resistant breeding lines over a 5-year period (Table 1).

Table 1. Mean leaf spot ratings from 1980 through 1984 of a common resistant check grown among relatively susceptible contributor entries and among resistant entries.

	Mean rating of FC(504 X 502/2) X SP 6322-0 in		
Year	Contributor tests	LSR breeding-line test	Difference
1980	3.0	2.7	0.3
1981	4.1	3.8	0.3
1982	3.5	3.0	0.5
1983	4.8	3.8	1.0
1984	3.8	3.4	0.4

Over a 5-yr period, a small amount of interplot interference was evident in our leaf spot nurseries, but mostly it was of no practical significance. In years of moderate epiphytotics (rating of 3-4 in resistant check), the resistant entry had a 0.3-0.5 lower rating than the plots among susceptible entries. There was a full disease grade difference in 1983, however, when the epiphytotic was more severe.

The small degree of interplot interference encountered in "normal" years is indicative of the uniformity achieved in establishing leaf spot epiphytotics within our nurseries from year to year. Contributing factors toward this uniformity, we believe, include: (1) the practice of two inoculations, 1 week apart; (2) the use of an environment-stabilizing perimeter of corn around the nursery; and (3) the interspersion of border rows of highly susceptible cultivars throughout the experimental area.

IDENTIFYING RESISTANCE TO CERCOSPORA LEAF SPOT BY SELECTING FOR RESISTANCE TO THE TOXINS "CERCOSPORIN" OR "CBT" (BSDF Project 91)

Initial bioassay trials with cercosporin--S. S. Martin and M. P. Steinkamp.

As is well known, the fungus Cercospora beticola causes an economically important leaf spotting disease of sugarbeet, Beta vulgaris. In culture, the fungus produces substances that are phytotoxic; two of these toxic materials are "cercosporin," a red compound having photodynamic properties and known chemical structure, and "cercospora beticola toxin (CBT)," a yellowish material of incompletely known structure. In previous work effective methods for the production, isolation, and purification of these two toxins were developed. Electron microscopic studies showed that both the fungus and the externally-applied isolated toxins could cause many of the same cellular degenerative changes in sugarbeet leaf tissue. In addition, morphological differences exist between lesions of relatively susceptible and relatively resistant sugarbeet cultivars. These facts suggest the possibility of using the purified toxins as selection tools to identify resistance to the fungus.

Because cercosporin is the better understood of the two C. beticola toxins, it was chosen for initial bioassay trials. Living tissue and cellular reaction to cercosporin by susceptible and resistant cultivars is being assessed first by light microscope techniques. Biochemical assays also will be incorporated in future stages of the work. Test plants for the trials reported here were R & G Pioneer, a cultivar highly susceptible to leaf spot, and the leaf spot resistant check cultivar long used in Fort Collins field tests [(FC 502/2 X FC 504) X SP 6322-0].

As a first step, stocks of cercosporin were prepared and purified by silica gel column chromatography to spectroscopic purity. (In addition to its use in the trials described here, purified cercosporin also was provided to BSDF Project 75 for bioassay against sugarbeet pollen and tissue cultures. This work will be reported later.) Several carrier solvents for cercosporin, which is very little soluble in water, were tested on leaf discs and petiole cross-sections from greenhouse-grown sugarbeets. The best results (i.e., the least deleterious solvent effect on tissue) were obtained with cercosporin at 1.0 ug/ml in 10% ethanol.

Results with cercosporin-ethanol solutions:

Tests were made by vacuum infiltration of leaf discs and petiolar cross sections obtained from relatively susceptible and resistant cultivars. Cercosporin in 10% ethanol or the 10% ethanol control was infiltrated for a 15 to 20 minute period. Test tissues then were rinsed in distilled water, placed in a Petri plate on distilled water wetted filter paper, and placed under fluorescent light. Tissue was examined through a 96 hour period.

Petiolar cross sections from the susceptible cultivar became chlorotic and browned deeply and more quickly than did controls. A similar but lesser effect occurred in the resistant cultivar. In both test cultivars the effect was more pronounced in cross-sections of petioles of immature leaves than in those of mature leaves from the same plant. Similar effects may have occurred in the leaf discs, but difficulties in infiltrating the toxin as well as the presence of large amounts of chlorophyll made this test less conclusive. Microscopic examination of the toxin-treated tissue suggested that accumulation of the dark material may be associated with or adjacent to

cell walls. In comparison with controls, toxin treated material of both cultivars contained many more plasmolyzed cells.

Results with an aqueous solution of cercosporin:

Because some microscopically-observable damage occurred in the ethanol-treated control tissue described above, we examined a second bioassay system which incorporated an aqueous solution of cercosporin (CN) at a concentration of 1.3 ug/ml. Petioles were cut from the youngest leaves of mature, greenhouse-grown plants of the resistant or susceptible cultivars. Cross-sections cut by hand with a razor blade were collected in glass distilled water and then transferred to the cercosporin test solution (1.3 ug/ml in glass distilled water), or to the glass distilled water (GDW) control. Treatment and control petiolar cross-sections were vacuum infiltrated for 20 minutes, after which one half of the cercosporin-treated group was rinsed briefly in fresh GDW, then again randomly split into two portions, each of which was transferred to GDW. The other half of the cercosporin-treated sections was similarly divided into two portions, each of which remained in one half of the CN treatment solution. Each group of sections was held in the appropriate solution in a 68 mm diameter watchglass, which in turn was contained in a Petri dish. Therefore, the experiment consisted of three treatments, summarized by listing infiltration solution/holding solution: CN/CN, CN/GDW, and GDW/GDW (control). Each of these was split into sub-treatments consisting of exposure to fluorescent light ("light) or placement in a closed, dark cabinet ("dark"). Tissues were examined by both a dissecting microscope and a transmitted light microscope after 16 hours. Observations are summarized in Table 1.

Table 1. Effect of cercosporin on cross-sections of susceptible (S) and resistant (R) sugarbeet leaf petioles.

Relative Resistance	Treatment	Tissue Darkening*	Chlorophyll Presence	Cytoplasmic Disruption
S	GDW/GDW/Dark	+	++++	-
R	GDW/GDW/Dark	+	++++	-
S	GDW/GDW/Light	+	++++	-
R	GDW/GDW/Light	+	++++	-
S	CN/GDW/Dark	++	++++	+
R	CN/GDW/Dark	+	++++	+
S	CN/GDW/Light	+++	++	++
R	CN/GDW/Light	++	+++	+
S	CN/CN/Dark	++	++++	+
R	CN/CN/Dark	+	++++	+
S	CN/CN/Light	+++	++	++
R	CN/CN/Light	++	+++	+

*Degree of effect indicated by increasing number of plus (+) signs. No effect is indicated by a minus (-) sign.

All control tissue, whether from resistant or susceptible cultivars and whether incubated in light or dark, showed only slight, superficial darkening of petiolar cross-sections during the time of observation. Chloroplast structure and cytoplasmic streaming remained normal. Darkening of tissue also occurred under cercosporin treatment, and except for the resistant cultivar incubated in the dark, always was more pronounced than was darkening of the controls. The greatest darkening effect occurred in tissue from the susceptible cultivar, incubated in the light. No differences from controls could be observed in chloroplasts or in apparent chlorophyll content of cercosporin-treated material incubated in the dark, but fewer intact chloroplasts were present in cercosporin-treated tissue held in the light. This effect was even more pronounced in susceptible cultivar tissue than in tissue from the resistant cultivar. Cytoplasmic disruption, as judged by the number of cells showing active cytoplasmic streaming, occurred in all cercosporin-treated tissue, whereas no disruption was evident in controls. Such cytoplasmic effects were most pronounced in cercosporin-treated tissue from the susceptible cultivar, incubated in the light (whether in CN or in GDW).

Although CN often is considered insoluble in water, these data confirm that a dilute water solution of CN is sufficient to produce deleterious physiological effects on sugarbeet leaf tissue. The fact that the observed effects were more pronounced in tissue incubated in light is consistent with the known photodynamic properties of CN. Thus, these preliminary trials have provided some evidence that susceptible and resistant sugarbeet cultivars may differentially react to CN *in vitro*, and that it may be possible to develop a laboratory bioassay to evaluate cultivars for their resistance to the fungus. Our continuing investigations will include response to the toxin CBT as well as to CN.

BIOLOGY AND PATHOGENICITY OF DIVERSE ISOLATES OF FUSARIUM FROM SUGARBEET (BSDF PROJECT 90)

Pathogenicity and Relative Virulence of Fusarium oxysporum Isolates from Subeet.--E. G. Ruppel.

A randomized complete block design with two replicates was used to test the pathogenicity and virulence of six Fusarium oxysporum f. sp. betae isolates from sugarbeet on Fusarium-resistant and susceptible cultivars. The isolates included WP and FO from California, FST-883 from Colorado, GWF-1a and 2 from Montana, and SSB-4 from Oregon. Test cultivars were resistant 75MSH194 and susceptible 75MSH3, supplied by the Great Western Sugar Company.

Seedlings were grown in autoclaved sand, watered with Hoaglund's nutrient solution. At 10 days of age, seedlings were individually transplanted to 10-cm-diameter clay pots containing autoclaved soil reinfested with the isolates. Isolates were grown on moist barley grain for 2 wk, which was then dried, ground in a Wiley mill, and added to soil at the rate of 1000 µg/g soil (1000 ppm). Plants grown in autoclaved soil containing 1000 ppm of sterile, ground barley grain served as controls.

After 30 days, seedlings were carefully washed from the soil, and the roots visually evaluated for root and vascular discoloration on an increasing disease scale of 0 to 5. Root length measurements also were made. Isolations from diseased roots were made on Fusarium-selective medium to confirm the presence of F. oxysporum. Mean disease ratings and root lengths are presented in Table 1.

The susceptible cultivar had more disease and significantly shorter root length than the resistant line. Part of the reduction in root length can be attributed to genetic differences between the lines (the susceptible control root length was only 58% that of the resistant control), but isolates FO, FST-883, GWF-1a and 2, and SSB-4 caused additional reduction in length.

Differences among isolates in disease ratings and root length were not significant. A small, but significant, line X isolate interaction was indicated for disease ratings. Additional work is needed to determine whether this interaction is real, which would indicate the existence of different pathogenic strains of the pathogen. Such knowledge is important to breeders working toward the development of resistance.

A small amount of disease was observed in the control plants, and F. oxysporum was isolated from their roots. Either the fungus was introduced via contaminated seed, or contamination of the control pots occurred during the experiment. Because strict measures were taken to avoid cross contamination during this study, seed-borne contamination seems more likely. Seed-borne inoculum would be an effective means to disseminate the pathogen to other beet growing areas from Oregon, where the fungus causes a stalk blight of flowering sugarbeet.

Additional isolates of F. oxysporum and other Fusarium spp. from sugarbeet also are being tested for pathogenicity and virulence in sugarbeet. Although tedious, transplanting seedlings to pathogen-infested soil so far has been the best inoculation method employed.

Table 1. Mean disease rating and root length of two sugarbeet cultivars grown in soil infested with six isolates of Fusarium oxysporum.

Cultivar	Isolate	Source	Disease rating[1]	Root length (cm)
75MSH3	WP	CA	4.0	5.7
(Susceptible)	FO	CA	3.5	2.8
	FST-883	CO	3.0	3.8
	GWF-1a	MT	4.0	2.8
	GWF-2	MT	5.0	0
	SSB-4	OR	1.5	4.0
	Control	--	0.5	5.5
Cultivar mean			3.1	3.5
75MSH194	WP	CA	1.0	7.0
(Resistant)	FO	CA	0.5	8.3
	FST-883	CO	1.5	6.8
	GWF-1a	MT	1.0	8.3
	GWF-2	MT	0.5	7.4
	SSB-4	OR	0.5	7.9
	Control	--	1.5	9.5
Cultivar mean			0.9	7.9

[1]Based on a scale of 0 to 5, with 0 = clean, healthy roots; 1 = some discoloration of feeder roots; 2 = some discoloration of tap root and feeder roots; 3 = tap root discoloration and rot of feeder roots; 4 = severe rot of tap root and feeder roots; 5 = plant dead.

RHIZOCTONIA ROOT ROT RESEARCH ON CONTROL AND ON DEVELOPMENT OF GENETIC RESISTANCE

(BSDF Project 20)

1984 Rhizoctonia Field Research.--R. J. Hecker and E. G. Ruppel.

All of our 1984 disease research was conducted on the Colorado State University South Farm. With the improvements that we have made, this site is proving to be ideal for our disease research. We are pleased and gratified to be a part of this three-way cooperative research involving the BSDF, Colorado State University, and ARS.

The 1984 rhizoctonia root rot research area had been fallow, barley, and corn in the preceding 3 years. Pests, other than the target pest, were not a problem in the experiment area. The experimental plots were one row, 6.1 m (20 ft) long and 56 cm (22 in) apart, except for the tests of the contributed lines where the plots were 4.3 m (14 ft) long. The experiments were planted May 9, except for the chemical control experiment (reported in a succeeding section) that was planted April 19. The experiments were thinned around June 8. Dry, ground, barley-grain inoculum of Rhizoctonia solani (R-9) was broadcast July 13 in a band over each row with a tractor-mounted four-row granule applicator. The amount of inoculum applied depended upon the relative resistance of the germplasms in the experiment. Our most resistant breeding lines received 9.4 g/20 ft of row, intermediately resistant germplasms received 5.9 g, and experiments with the most susceptible lines received 3 g. Intermittent sprinkler irrigation was used to moisten and activate the inoculum.

The roots in all experiments were lifted between September 11 and 14 and individually rated for root rot. Disease index (DI) ratings were made on a scale of 0 to 7 (0 = no evidence of infection; 7 = plant dead and extensively decomposed). The percentage of healthy roots were those with index ratings of 0 and 1, those roots showing no active infection. The roots rated 0 through 3 also were analyzed as a class; these roots, in general, were sufficiently sound and large to be recovered in a commercial harvest. The epiphytotic of root rot in our 1984 rhizoctonia experiments was moderately severe and about optimum for the evaluations of the various experiments.

The succeeding sections under this BSDF Project 20 report describe individual experiments in our 1984 rhizoctonia root rot research project.

Resistance Evaluations of Germplasms from the Rhizoctonia Root Rot Resistance Development Project.--R. J. Hecker and E. G. Ruppel.

The need for sugarbeet cultivars with high levels of rhizoctonia root rot resistance continues to be a high priority among sugarbeet growers, particularly in certain growing areas. Resistant commercial hybrids can come only from the use of resistant parents. Current hybrid cultivars offering some resistance have utilized resistant germplasm from our BSDF Project 20 in only one parent of the hybrid. Maximum resistance will be achieved when all parents in a hybrid are highly resistant. In this resistance development project, we have been attempting to develop resistance in pollinator and male sterile germplasms. Although the greatest amount of time and effort has been spent on multigerm germplasms, in recent years monogerm and O-type germplasms have received additional effort.

The disease resistance ratings of the most promising multigerm breeding lines are given in Table 1. The most resistant line, FC 707/2, had a DI in the inoculated nursery of 1.7, and 59% of the roots were rated as healthy. The predecessor of this line, FC 707, was released in 1981. FC 707 (4x) also showed good resistance in 1984; it will be considered for germplasm release following one or two more generations required for stabilization of the tetraploid condition. FC 712, with a DI of 1.9, is currently in process of being officially released. This germplasm has shown relatively high combining ability in preliminary tests (see 1983 BSDF report). This line has been derived from a composite cross of nine of the most resistant germplasms that were in our program in 1978. Entry 381 is a diverse germplasm derived through several cycles of resistance selection from a pool of USSR multigerm cultivars. It represents rather rapid development of a significant amount of resistance in a diverse germplasm. The individual USSR multigerms used in this pool were all classed as rhizoctonia susceptible when our resistance selection effort was commenced. In addition to those breeding lines listed in Table 1, about 70 other germplasms in various stages of development were tested.

The most promising resistant germplasms that are monogerm, or are segregating for monogerm, are listed in Table 2. Except for FC 708 and its CMS, there are no lines acceptable from a resistant standpoint that are yet useful for commercial utilization. Entry 331 has relatively good resistance and is segregating for monogerm, but its extremely low vigor, aerial root growth, and low seed productivity preclude any commercial utilization at this point. Our general experience is that rhizoctonia resistance is more difficult to identify and isolate in monogerm vs multigerm germplasms. However, results with FC 708 indicate that rhizoctonia resistance and monogermness are not inversely related.

In long-term germplasm improvement projects such as this, progress is sometimes so gradual that it is difficult to measure. The groups of related germplasms in Table 3 provide an opportunity to assess progress made with our cyclic mass selection procedure. Within each group, e.g. FC 701, each subnumber designates a subline developed from the previous cycle or generation. Missing subnumbers indicate that there was not enough seed to include that source in the test. FC 701, FC 702, and FC 703 each commenced from susceptible germplasms that were little different than the susceptible check, FC 901. The data in Table 3 represent progress within these families since commencement of a systematic cyclic recurrent selection system. Significant progress toward resistance is demonstrated in each of the families, with the greatest progress shown in FC 701 and FC 703. It appears that FC 702 source germplasm had inherently less genetic variability for resistance than the other two families. FC 702/1, with a DI of 2.7, appears to be an anomaly in this 1984 test, because none of its subsequent generations equaled it. From the example of these lines in Table 3, we conclude that a recurrent cyclic selection system successfully identified and isolated resistant genotypes, although genetic gains were achieved in only modest increments.

In the past, we have investigated numerous other methods of assessing the resistance of the sugarbeet sporophyte, all the way from embryo to mature root. None of the techniques tested proved to be as good as our field inoculation and selection techniques. We are currently in the process of

inoculation and selection techniques. We are currently in the process of studying the sugarbeet gametophyte as a potential tissue for identification of resistance.

Table 1. Means of most promising multigerm resistant lines for disease index (DI), % healthy roots, and % of roots rated 0-3 (Exp. 4R, 84).

Entry	Description	DI	% healthy roots	% rated 0 - 3
372	FC 707/2	1.7	59	92
340	FC 707 (4x)	1.8	58	87
376	FC 712	1.9	56	83
374	FC 710	1.9	55	82
366	FC 705	2.0	50	80
364	FC 703/5	2.1	48	79
367	FC 705/1	2.2	39	81
371	FC 707/1	2.3	48	69
369	FC 706	2.4	40	76
373	FC 709	2.5	36	69
380	Sib line of FC 710	2.5	35	70
370	FC 707	2.6	38	69
368	FC 705/2	2.8	27	65
381	Rh. resist. MM (USSR orig.)	2.8	33	64
375	FC 711	3.3	22	58
365	FC 704	3.5	18	61
377	FC 801	3.8	17	43
401	C 37 (LSR) X FC 707/2, F_2	4.7	16	34
378	FC 703; resist. check	3.3	22	53
342	FC 901; susc. check	6.6	2	6
	LSD (.05)	0.7	11	10

Table 2. Means of various monogerm (or segregating for monogerm) lines being selected for Rhizoctonia resistance; DI, % healthy roots, and % of roots rated 0 - 3 (Exp. 5R, 84).

Entry	Description	DI	% healthy roots	% rated 0 - 3
338	FC 708	2.5	30	84
339	FC 708 CMS	2.6	36	75
331	Synthetic of 24 resist. inbred lines	2.1	43	86
379	Syn. from SP 5831-0	2.4	40	73
391	Resist. select. from mm of USSR origin	5.8	4	13
395	(LSR-CTR X FC 708)F_2	5.0	15	25
403	(FC 607 CMS X FC 708) CMS, F_2	4.8	17	30
402	(FC 607 X FC 708), F_2	4.6	22	38
405	Polish high suc. mm X FC 709, F_2	4.5	21	37
407	1st Cy (high CA line X FC 708)	4.5	17	38
408	1st Cy (LSR, high CA line X FC 708)	3.8	30	50
409	1st CY (LSR, high CA line, CMS X FC 708)	4.5	19	35
410	2nd Cy (3 high CA lines X FC 708)	3.5	31	50
382	HH 32	6.0	3	9
417	Mono Hy RH 83	5.9	7	15
415	FC 703; resist check	3.5	31	46
400	FC 901; susc. check	6.2	7	12
	LSD (.05)	0.8	10	12

Table 3. Progress toward Rhizoctonia resistance through cyclic mass selection (1984 test).

Description	DI	% healthy	% rated 0 - 3
FC 701	4.5	15	29
FC 701/2	4.0	19	40
FC 701/4	4.0	21	42
FC 701/4 (4x)	2.8	36	67
FC 701/5	3.0	30	56
FC 701/6	2.5	40	69
FC 702	4.7	12	30
FC 702/1	2.7	34	65
FC 702/2	4.8	13	29
FC 702/4	5.0	7	22
FC 702/4 (4x)	4.2	21	42
FC 702/5	4.4	14	40
FC 702/6	3.7	23	49
FC 702/7	3.3	25	53
FC 703	4.2	13	33
FC 703 (4x)	3.5	23	46
FC 703/1	3.9	14	40
FC 703/2	3.5	20	48
FC 703/3	3.3	23	56
FC 703/4	3.0	28	60
FC 703/5	2.1	48	79
FC 901; susc. check	6.6	2	6
LSD (.05)	0.7	11	10

Soil Temperature as a Criterion for Fungicide Timing to Control Rhizoctonia Root Rot in Sugarbeet.--E. G. Ruppel and R. J. Hecker.

Several fungicides have shown potential for controlling rhizoctonia root rot under artificial conditions in experimental field plots. Mostly, fungicides were applied immediately before or just after inoculation of the plants. Growers, however, need to know when to apply chemicals under conditions of natural penetration by the fungus. Because the activity of Rhizoctonia is positively correlated with soil temperature, the main objective of this study was to determine whether soil temperature is a suitable criterion for the timing of fungicide application under quasi-commercial conditions in the field, i.e., without artificial inoculation of the plants.

A randomized block design with five replicates was used to test the efficacy of three fungicides for controlling rhizoctonia root rot in commercial sugarbeet cultivars Mono-Hy RH 83 (moderately resistant) and Mono-Hy A4 (susceptible). The experiment was located on a site known to be heavily infested with Rhizoctonia solani. Additionally, barley-grain inoculum of R. solani (isolate R-9) was broadcast and incorporated over the experimental site at 50 lb/acre (56 kg/ha) just before planting on April 19. Two-row plots were 20 ft (6.1 m) long, with rows 22 in (56 cm) apart.

Soil temperatures were monitored daily at 1- and 2-in (2.5 and 5.1 cm) soil depths beginning May 2. Since R. solani is inactive at soil temperatures below 61 F (16 C), initially we planned to apply the fungicides when maximum soil temperature reached 61 (16 C), 68 (20 C), and 73 F (24 C). Due to extreme variability in soil temperatures, however, single applications were made at either cotyledon stage (early), 4- to 6-leaf stage (mid), or just before layby (late) when the plants were almost covering the furrows on May 14, May 30, and July 6, respectively. Maximum 1-in soil temperature on these dates was 87 (30.5 C), 90 (32 C), and 78 F (25.5 C), respectively.

Fungicides were applied once with a CO_2-powered bicycle sprayer adapted for using 2-liter plastic soft-drink bottles, and with #8006 banding nozzles turned parallel to the row. The height of the sprayer boom was adjusted to deliver a 4-in (10-cm) band in the beet crowns at 17 psi (120 kPa).

Fungicides used included pencycuron (Bay NTN 19701) 75% wettable powder (WP), triadimefon (Bayleton) 50% WP, and triadimenol (KWG 0519, formerly Baytan) 25% dried flowable at the active ingredient rate of 1.4 oz (39.7 g), 0.5 oz (14.2 g), and 0.5 oz (14.12 g) per 1000 ft (305 m) of row, respectively. Each chemical was suspended in water, and applied at the rate of 10.6 qt (10 liters) water per 1000 ft (305 m) of row. Nontreated plots served as controls. None of these fungicides currently is registered for control of rhizoctonia root rot in sugarbeet.

On October 3, all beets were dug and evaluated for root rot on a scale of 0 to 7, with 0 = no rot and 7 = plant dead. A disease index (DI) was calculated for each plot. Plants in classes 0 and 1 were combined to calculate the percentage of healthy roots. All roots 2 in (5.1 cm) or larger in diameter were weighed to determine root yield, and sucrose percentages were determined by standard laboratory procedures. All data were statistically analyzed.

Results are presented in Table 1. Under a relatively intense rhizoctonia epiphytotic, the resistant cultivar Mono-Hy RH83 had less disease and greater root yield than the susceptible cultivar Mono-Hy A4. Compared with the non-treated controls, fungicide treatments significantly decreased the severity of root rot 16-54%, increased % healthy roots 118-254%, increased % sucrose 11-26%, and increased root yield 15-77% in the susceptible cultivar but had no beneficial effects on the resistant cultivar. Percent sucrose means for early, mid, and late fungicide applications were 10.0, 9.9, and 10.5, respectively, with the late application mean being significantly greater than the early and mid means. Root-yield means for fungicides across both cultivars were 21.9, 18.6, and 22.3 T/acre (49.1, 41.7, and 50.0 t/ha) for pencycuron, triadimefon, and triadimenol, respectively, with the yield from triadimefon-treated plots being significantly less than yields from the other treatments. Daily maximum or 24-hr average soil temperatures were too variable and unreliable to serve as criteria for timing fungicide applications.

Table 1. Effect of three fungicides at three application dates on the response of resistant and susceptible sugarbeet to infection by *Rhizoctonia solani* in a quasi-commercial field test.[1]

Cultivar	Treatment[2]		D.I.[3]	% healthy[4]	% sucrose	Roots T/A
Mono-Hy RH83 (Resistant)	Pencycuron	Early	2.2 bc	65.9 a	9.7 a	21.5 a
		Mid	2.8 ab	52.2 ab	10.3 a	20.4 a
		Late	2.2 bc	63.2 a	10.9 a	22.4 a
	Triadimefon	Early	2.5 bc	53.3 ab	9.6 a	21.3 a
		Mid	3.6 a	41.8 b	9.9 a	17.6 a
		Late	2.0 bc	66.9 a	10.9 a	21.7 a
	Triadimenol	Early	1.8 c	67.2 a	10.8 a	23.9 a
		Mid	2.2 bc	59.2 ab	10.2 a	22.1 a
		Late	1.9 bc	68.4 a	10.5 a	23.0 a
	Nontreated	---	2.2 bc	56.1 ab	10.5 a	21.9 a
Mono-Hy A4 (Susceptible)	Pencycuron	Early	2.8 yz	54.0 x	10.0 xy	21.9 vwx
		Mid	2.7 z	53.1 x	10.3 xy	22.7 v
		Late	2.4 z	60.2 x	10.1 xy	22.3 vw
	Triadimefon	Early	4.2 x	28.5 yz	9.5 xy	17.8 xy
		Mid	3.5 xy	42.5 xy	9.3 yz	18.2 wxy
		Late	4.1 x	29.0 yz	10.4 x	15.1 yz
	Triadimenol	Early	2.4 z	57.4 x	10.4 x	23.2 v
		Mid	3.5 xy	39.2 xy	9.6 xy	19.4 vwx
		Late	2.3 z	61.9 x	10.6 x	22.3 vw
	Nontreated	---	5.0 w	13.3 z	8.4 z	13.1 z

[1]Means of five replicates; means within columns within each cultivar followed by the same letter are not significantly different at $P = 0.05$. (Due to a highly significant cultivar X fungicide interaction in most overall analyses of variance, separate analyses were performed on data from each line.)

[2]Pencycuron applied at 1.4 oz a.i./1000 ft of row, whereas triadimefon and triadimenol were applied at 0.5 oz a.i./1000 ft of row. Chemicals were applied once, banded down the row and into the beet crown. "Early" application (May 14) was made at the cotyledon stage, "Mid" application was made at the 4- to 6-leaf stage (May 30), and "Late" application (July 6) was made just before layby when the plants were almost covering the furrows.

[3]D.I. (Disease Index) based on a scale of 0-7, with 0 = no rot and 7 = dead.

[4]% healthy = disease classes 0 and 1 combined. Statistical analyses were performed on data transformed to arcsines.

Consistency Among Annual Rhizoctonia Resistance Evaluations.--E. G. Ruppel and R. J. Hecker.

Each year, artificial rhizoctonia root rot epiphytotics are established in the field at Fort Collins, Colorado, to evaluate the resistance of sugarbeet lines submitted by BSDF-member companies. For the past 6 years, with one exception (1982), disease intensity of our resistant (FC 703) and susceptible (FC 901) controls has been remarkably uniform (Table 1). Such consistency indicates that our techniques and procedures are effective in differentiating genotypes having varied degrees of resistance to Rhizoctonia solani.

Table 1. Mean disease ratings of a resistant (FC 703) and susceptible (FC 901) control in rhizoctonia breeding nurseries, 1979-1984.

Year	Line	Disease index[1]	% healthy[2]	% in grades below 4
1979	FC 703	2.5	40	70
	FC 901	6.1	1	6
1980	FC 703	2.9	34	66
	FC 901	5.9	< 1	4
1981	FC 703	2.9	26	66
	FC 901	6.1	< 1	6
1982	FC 703	1.8	66	89
	FC 901	4.6	20	39
1983	FC 703	2.8	29	64
	FC 901	5.9	1	8
1984	FC 703	2.5	46	71
	FC 901	6.2	3	9

[1]Disease index based on a scale of 0 to 7, with 0 = no rot and 7 = dead.

[2]% healthy calculated by combining disease classes 0 and 1.

Evaluation of Contributed Lines for Resistance to Rhizoctonia Root Rot.--E. G. Ruppel and R. J. Hecker.

Randomized complete block designs with five replicates were used to evaluate 53 contributed lines from three BSDF-member companies. Internal control lines included highly resistant FC 705/1, resistant FC 703, and highly susceptible FC 901. Results of each contributor's test were statistically analyzed and sent to company breeders. The mean disease indexes for FC 705/1, FC 703, and FC 901 across all tests were 1.5, 2.5, and 6.2, respectively (scale of 0 to 7). Percent healthy means were 68, 46, and 3%, whereas % roots in classes 0 through 3 were 90, 71, and 9, respectively.

CLARIFICATION OF SUGARBEET EXTRACTS
(BSDF Project 81)

Inhibition of Sugarbeet Polyphenol Oxidase by 2-Mercaptoacetic acid.--S. S. Martin.

A previous report (Sugarbeet Research Report, 1983) described the effectiveness of 2-mercaptoacetic acid (2-MAA) as a clarificant for sugarbeet brei extracts, and presented summarized data on sucrose, sodium, potassium, and amino N concentrations in 2-MAA clarified extracts in comparison with aluminum chloride clarified extracts. This report will illustrate further the involvement of polyphenol oxidase (PPO) in extract darkening, and the effect of 2-MAA on this process.

The oxidative darkening reaction of an aqueous sugarbeet root extract was followed spectrophotometrically to obtain basic information on the time course of the reaction. Root tissue was cut into thin slices which immediately were placed on dry ice. Frozen tissue was weighed, then extracted by 2.5 minutes of combined mechanical homogenization and sonication in ice-cold, nitrogen-purged glass distilled water (1:5 fr wt/vol), maintaining the homogenizing mixture in an ice-water bath. The cold homogenate quickly was passed through a cheesecloth prefilter onto a Büchner filter fitted with Whatman No. 1 filter paper; the filtrate was collected in a filter flask held in an ice-water bath. A portion of the filtrate immediately was transferred to a spectrophotometer cuvet, and the reaction was followed for three hours at room temperature. A computer-controlled diode array spectrophotometer permitted the recording of full ultraviolet and visible wavelength spectra (200-800 nm) at five minute intervals, as well as subsequent mathematical manipulation of the data.

The filtered aqueous extract initially was slightly turbid and nearly colorless. The first spectrum recorded immediately after insertion into the spectrophotometer (time 0) showed high UV absorption and general absorption throughout the visible range without clear absorption maxima. Spectra were similar but at increasing absorption levels throughout the three hour period, during which the extract passed visibly from nearly colorless to light orange to gray to black. Computer calculation of difference spectra (the spectrum at any chosen time minus the spectrum at any preceding time) provided the best indication of the chemical processes underlying the oxidative darkening. The solid line of Figure 1 shows such a difference spectrum: the spectrum at time 0 (start of spectrophotometric examination) was subtracted from the spectrum at time 15 minutes). Within this time period, absorption maxima were at 305 and 476 nm. This spectrum strongly suggested that of dopachrome, a compound recognized as a product of PPO oxidative effects on tyrosine and 3,4-dihydroxyphenylalanine (DOPA). For comparison, I synthesized dopachrome by oxidation of DOPA with MnO_2; its spectrum is co-plotted on Figure 1 (dashed line). The spectral information implies the formation of dopachrome (which is orange-red and accounts for the orange color observed during air oxidation of the sugarbeet aqueous extract). Difference spectra for subsequent 15 minute periods ($t_{30} - t_{15}$) and ($t_{45} - t_{30}$) show loss of dopachrome into subsequent melanization products which have only general visible absorption without the 476 nm maximum (Figure 2). These data illustrate the rapidity of oxidative effects on sugarbeet extracts, and implicate PPO as the major factor in brei extract

oxidative blackening.

To examine the properties of sugarbeet polyphenol oxidase *in vitro*, a crude enzyme preparation was made as follows:

Freshly prepared sugarbeet brei held in a cooling bath at -30°C was extracted twice with -20°C acetone. The acetone-extracted brei was held on dry ice while being transported to the main laboratory, where it was stored at -20°C until further use.

Portions of the frozen brei were freeze-dried at -50°C. Lyophilized brei was extracted with cold, nitrogen-purged 0.05 M pH 6.8 sodium phosphate buffer (1:20 w/v) by simultaneous mechanical homogenization and sonication for about 2 minutes. The mixture was held in an ice water bath to minimize potential oxidative effects. The homogenized suspension was immediately Büchner filtered through Whatman No. 1 preceded by four layers of cheesecloth, with the suction flask again held in an ice water mixture. Each enzyme preparation was held at 4°C and used the day of preparation.

The oxidation of tyrosine substrate by the sugarbeet PPO was followed spectrophotometrically in a 6.0 ml reaction mixture that included 0.6 mM tyrosine, 41 mM sodium phosphate buffer (pH 6.8), and 1.0 ml of sugarbeet PPO prepared as described above. The reaction mixture excluding the enzyme was prepared at room temperature, then the enzyme was added last, the mixture was vortex mixed, and a portion was transferred to a spectrophotometer cuvet. Absorption spectra were recorded at 5 minute intervals beginning exactly 1.0 minute after the start of enzyme addition to the reaction mixture. Figure 3 shows the change in absorption spectrum of such a preparation with time. Both the clear appearance of absorption maxima at 305 and 476 nm and the general increase of broad absorbance in the visible range are illustrated in these figures, corresponding to the visually noted change in the reaction mixture from almost colorless to orange-red to gray-black within 2 hours. A plot of the spectrum of the reaction mixture at 10 minutes minus the spectrum of the same preparation at time 0 (i.e., the first spectrum obtained at 1.0 min. after start of enzyme addition; Figure 4) illustrates clearly the formation of dopachrome (maxima at 305 and 476; compare with the dopachrome spectrum shown in Figure 1 above).

Because the formation of color in oxidative blackening of extracts often has been reported in the literature as absorbance at 420 nm, the data from the oxidation of tyrosine by sugarbeet PPO were compared for absorbance at 420 nm, 476 nm, and the mean absorbance from 400 to 600 nm, over a two hour reaction period (Table 1).

The close correspondence of these data is confirmed by the correlation coefficients:

Data pair	Corr. coeff. (r)
A_{420} & A_{476}	0.997
A_{420} & $A_{(mean,\ 400\text{-}600)}$	1.00
A_{476} & $A_{(mean,\ 400\text{-}600)}$	0.998

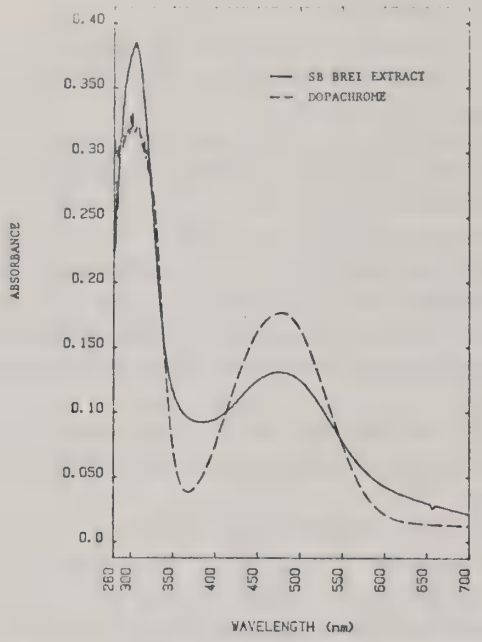

Figure 1. Change in absorbance of a sugarbeet aqueous extract during the first 15 minutes at room temperature (solid line). The dashed line is the spectrum of synthesized dopachrome.

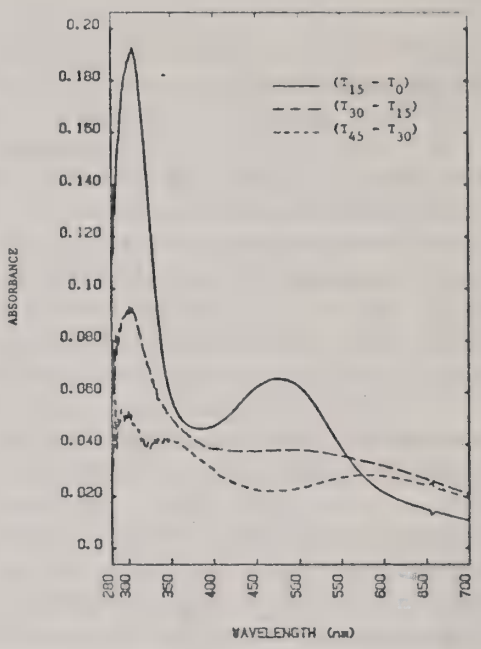

Figure 2. Change in absorbance of a sugarbeet aqueous extract during the first three 15-min. periods at room temperature.

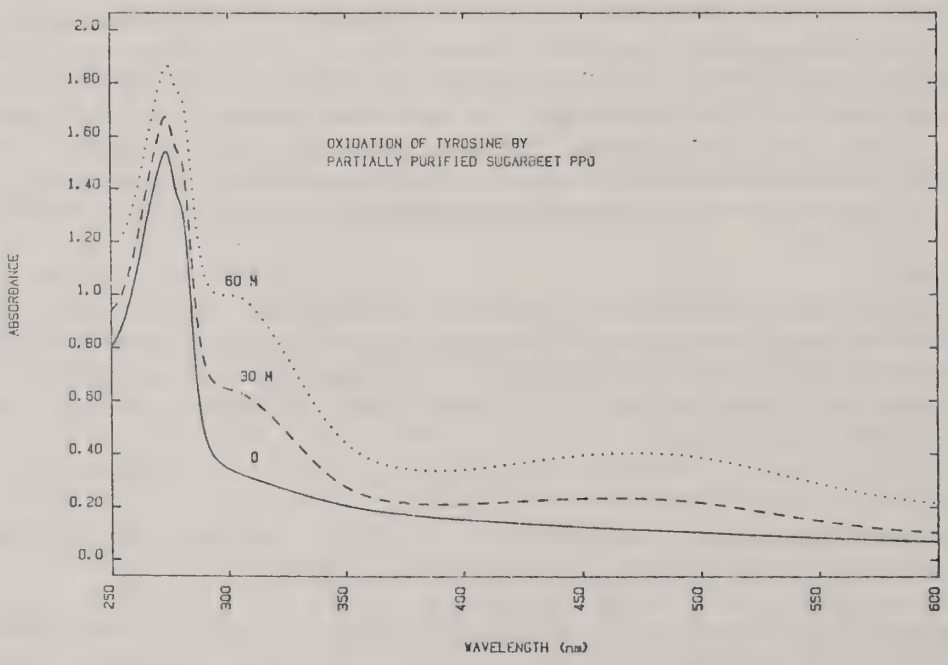

Figure 3. Absorption spectra of the oxidation of tyrosine catalyzed by sugarbeet polyphenol oxidase.

Table 1. Time course of absorbance at 420, 476, and mean absorbance from 400 to 600 nm for the oxidation of tyrosine by sugarbeet polyphenol oxidase.

Time (min.)	A_{420}	A_{476}	$A_{(mean, 400-600)}$
0	0.139	0.112	0.103
5	0.144	0.121	0.108
10	0.154	0.137	0.118
15	0.167	0.157	0.131
30	0.221	0.231	0.188
45	0.284	0.312	0.255
60	0.362	0.402	0.337
75	0.442	0.492	0.423
90	0.545	0.591	0.525
105	0.586	0.624	0.566
120	0.620	0.645	0.599

Thus, the increase in color resulting from the catalysis by sugarbeet PPO of tyrosine hydroxylation and subsequent oxidation could be determined equally well over this period by any of these absorbance measures.

The effect of 2-MAA on sugarbeet PPO was examined by incorporating various test quantities into the reaction mixture described above; concentrations of tyrosine, buffer, and enzyme were unchanged. The presence of 2-MAA at 0.017% in the total reaction mixture totally inhibited the oxidation of tyrosine (Figure 5). This concentration appeared to be the minimum necessary for full enzyme inhibition, as halved 2-MAA concentration (0.008%) allowed some activity. Figure 6 presents the difference spectrum of the reaction mixture including 0.017% 2-MAA, at 0 and 60 minutes; this shows that no significant change in absorbance occurred over the entire ultraviolet and visible range (200-800 nm).

The effective inhibition of sugarbeet PPO by 2-MAA provides a useful means of clarifying sugarbeet brei extracts with very small amounts of an added reagent. Because physical removal of components of the oxidative blackening reaction is not a factor, it seems likely that clarification by this method results in an extract that is truly representative of the water-extractable constituents of the sugarbeet root. Thus, differences in chemical analyses of extracts clarified by 2-MAA and those clarified by traditional methods (lead or aluminum, in particular) are to be expected, but one should not assume the 2-MAA samples provide less acceptable results. If anything, the opposite may be true.

Further studies of sugarbeet polyphenol oxidase are in progress.

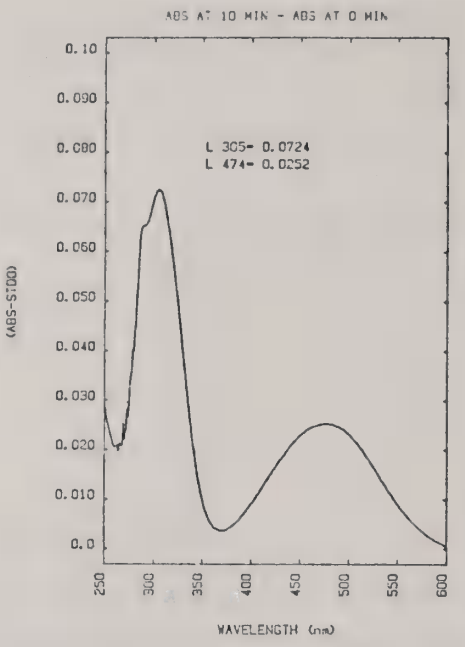

Figure 4. Difference spectrum showing absorption changes in the first ten minutes of tyrosine oxidation catalyzed by sugarbeet polyphenol oxidase.

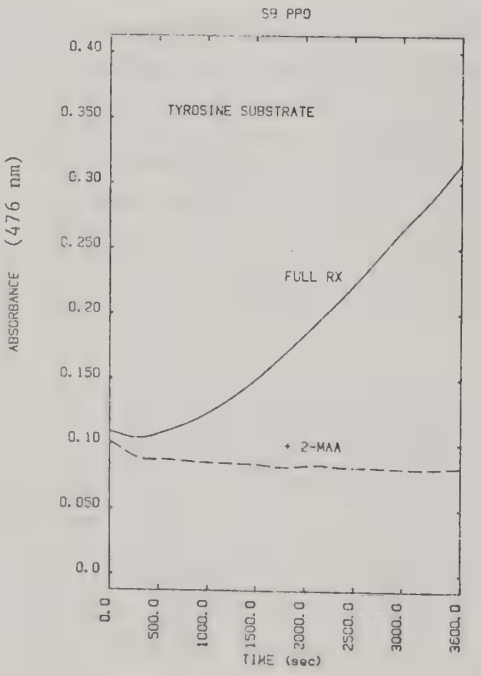

Figure 5. Time course of the oxidation of tyrosine by sugarbeet polyphenol oxidase, in the absence ("full rx") or presence (+ 2-MAA) of 2-mercaptoacetic acid.

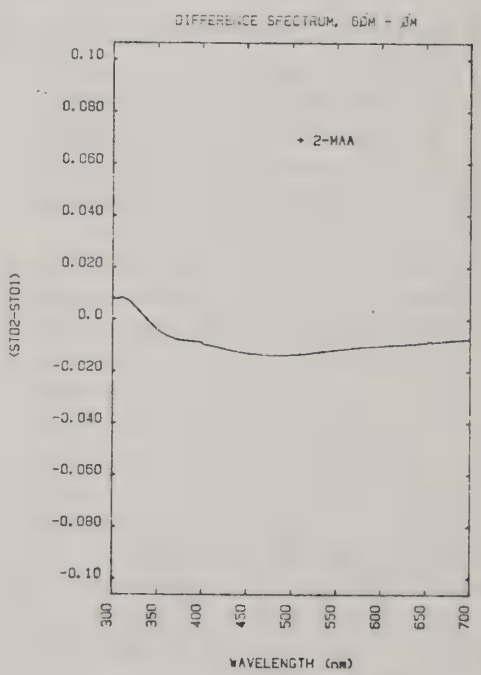

Figure 6. Absorption difference spectrum over 60 minutes reaction time of the oxidation of tyrosine by sugarbeet polyphenol oxidase with 2-MAA present.

OTHER REPORTS OF INTEREST TO BSDF MEMBERS

Rhizomania-Like Disease in Colorado.--E. G. Ruppel.

In late July 1984, a rhizomania-like disease was observed in a varietal field trial of the Great Western Sugar Company in Longmont, CO. Stunted, unthrifty beets were seen in a small 15' X 10' area. Leaves of affected plants were reduced in size, pale green in color, and somewhat upright in habit; no vein-banding or necrosis was evident. Tap roots of such plants were at least 50-60% smaller than nearby healthy roots, and extremely proliferated secondary roots gave the so-called "bearded" appearance of beets affected with rhizomania. The typical constriction of the tap-root crown area, as seen in rhizomania beets, was not pronounced. Beets growing in the perimeter of the severely affected area appeared healthy, except for some secondary-root proliferation. Cysts of Heterodera schachtii were rare on any of the severely or mildly affected roots.

Severely affected roots were brought to the laboratory in Fort Collins, and secondary roots were examined microscopically. In all samples, secondary roots were heavily infested with Polymyxa betae, the fungal vector of beet necrotic yellow vein virus (BNYVV), and Olpidium sp. Juice extractions from secondary roots prepared in 0.01M phosphate buffer (pH 7) containing 1.0% 2-mercaptoethanol were used to inoculate silicon carbide-dusted leaves of healthy sugarbeets and Chenopodium quinoa plants in the greenhouse. Eight diseased roots were sent to James E. Duffus in Salinas, CA, for virus determinations via enzyme-linked immunosorbent assays (ELISA).

Although visual and microscopic observations indicated a BNYVV etiology of the rhizomania-like disease in Colorado, no virus was detected in either the inoculation or ELISA tests. Because BNYVV by itself can induce rhizomania (J. E. Duffus, personal communication), it seems unlikely that the observed symptoms were caused by Polymyxa alone, although the heavy concentration of cystosori in root cells certainly must have a deletorious effect on normal root growth.

The cause of the disease observed in Colorado remains unknown. However, the occurrence of rhizomania-like symptoms in the absence of BNYVV points to the necessity for virus assays to verify or rule out a virus etiology.

SUGARBEET RESEARCH

1984 Report

Section D

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Sugarbeet Research and Education Board of
Minnesota and North Dakota

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CONTENTS

AN INHIBITOR OF *CORYNEBACTERIUM SEPEDONICUM* FROM SUGARBEET

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Introduction.--An array of bacteria live within sugarbeet roots. Theoretically, these bacteria could be contributing to the degradation of sucrose that occurs in stored sugarbeets. A series of experiments were performed to study sucrose hydrolytic enzymes of both the sugarbeet root and the root's bacterial inhabitants. During the course of this investigation it was discovered that an ammonium sulfate fraction from sugarbeet inhibited levansucrase and the growth of *Bacillus circulans* and *Corynebacterium sepedonicum*. *Bacillus circulans* is a common soil inhabitant that was isolated from healthy sugarbeet root tissue and was one of the most rapid hydrolyzers of sucrose compared to 31 other bacterial isolates taken from sugarbeet. The sucrose produced by *B. circulans* was shown to be levansucrase. *Corynebacterium sepedonicum* causes ring rot of potato. Ring rot is a vascular wilt that is considered the most destructive disease of potatoes in North America. Partial purification and characterization of this inhibitor was done and the results are reported here.

Results.--The estimate of molecular weight for the inhibitor was 560 based on filtration through a calibrated gel column.

The inhibitor was effective against levansucrase purified from *B. circulans* but not invertase from *Candida utilis* because when increasing amounts of inhibitor were added to the assay mixture containing invertase or levansucrase there was a corresponding decrease in levansucrase activity but a constant level of invertase activity.

Tannin was not present in the partially purified preparation of the inhibitor because gelatin did not precipitate when mixed with the inhibitor.

The inhibitor reacted positively with ninhydrin to indicate the presence of -amino acids. The inhibitor also reacted positively with the Somolgyi assay to indicate the presence of reducing sugars. The sugar component apparently is a fructose or fructosyl moeity because an assay of the inhibitor using the hexokinase-phosphoglucose isomerase procedure gave a negative reaction for glucose and a positive reaction for fructose.

The inhibitor proved to be stable to heat. It was not deactivated by exposure to a boiling water bath for 15 min nor to autoclaving for 20 min at 15 psi.

The data in Table 1 show that the inhibitor was able to reduce the effects of *C. sepedonicum* on tomato plants in the greenhouse. Stunting of inoculated tomatoes increased as the amount of inhibitor mixed with the inoculum was decreased. The inhibitor also had an effect on the total bacterial population within the tomato stem bases because the bacterial count in this tissue decreased as the amount of inhibitor in the inoculum increased.

Table 1. The effect of a levansucrase inhibitor on the growth of tomato inoculated with Corynebacterium sepedonicum and on the bacterial count of tomato tissue.

Inhibitor, % (v/v)	Fresh wt., gm	bac/gm, X 1000
none	105	19
2	78	28
4	288	3
8	329	9
16	372	2
32	345	2

Tomatoes in the 2-3 leaf stage were inoculated by dipping roots in a 10^{-6} suspension of bacteria and the inhibitor.

Inhibitory activity against levansucrase was present in extracts from other plants but none possessed the 100% inhibition expressed by the sugarbeet root extracts. Extracts from potato tubers and eggplant fruit had no inhibitory activity (Table 2).

Table 2. The inhibition of levansucrase activity in extracts from several sources expressed as a per cent of activity in assay mixtures with no extracts.

Source	% Inhibition
Sugarbeet root	100
Tomato leaves	32
Sugarbeet leaves	23
Eggplant leaves	15
Carrot root	14
Potato tuber	0
Eggplant fruit	0

The inhibitor stopped the growth of C. sepedonicum and one strain of Bacillus circulans in broth culture. The growth of other bacteria was inhibited 0 - 87% (Table 3).

Table 3. Growth inhibition in broth culture with 2% levansucrase inhibitor.

	Bacterium	% Inhibition
1.	Corynebacterium sepedonicum	100
2.	Bacillus circulans	100
3.	Corynebacterium nebraskense	87
4.	Streptococcus mutans	68
5.	Leuconostoc mesenteroides	18
6.	Xanthomonas sp.	14
7.	Erwinia rhapontici	12
8.	Pseudomonas syringae	7
9.	Bacillus subtilis	0
10.	Pseudomonas marginalis	0
11.	Erwinia caratovora	0
12.	Erwinia herbicola	0
13.	Corynebacterium betae	0
14.	Corynebacterium insidiosum	0
15.	Corynebacterium michiganense	0

The inhibitory activity that could be extracted from roots decreased when the roots were deprived of oxygen or frozen and thawed. The magnitude of the decrease (80 - 86%) was similar for either treatment (Table 4).

Table 4. The activity (units)[a/] of levansucrase inhibitor from freshly harvested or stored sugarbeet roots.

Treatment[b/]	Roots	
	stored	fresh
	Units	Units
Untreated	161	123
Fermented	25	27
Frozen-Thawed	21	24

[a/] Unit = that amount of inhibitor in 1 ml that decreases the activity of levansucrase by 50%.

[b/] Fermented = roots were submerged in 0.1% sodium hypochlorite for 3 days then removed and incubated for 4 days at room temperature; frozen-thawed = roots were placed at -16 C for 3 days, then 4 days at room temperature.

Discussion.--This research provides evidence that immunity of an incompatible host to a resident pathogen is provided by a preformed inhibitor of levansucrase. The inhibitor content in sugarbeet roots would account for the inability of C. sepedonicum to grow and cause a disease after it has infected the sugarbeet. The lack of this inhibitor in potato tubers accounts for the success of this bacterium as a cause of major damage to potatoes. The specificity of this inhibitor for sucrases other than the invertase tested here or the nature of the sucrase enzyme of C. sepedonicum has not been thoroughly investigated so conclusions regarding the precise mode of inhibition can not be made.

The differential response of the four species of Corynebacterium to the inhibitor suggests different sucrase enzymes among the four and possibly a similar sucrase betwen C. sepedonicum and C. nebraskense because the latter two were strongly inhibited.

Sugarbeet roots as well as other storage organs probably contain inhibitors to prevent the destruction of vital energy reserves such as sucrose and starch. The activity of the inhibitor reported here suggests some specificity because it was not effective against an invertase produced by Candida utilis although it could be effective against invertases from other sources. The selective inhibition against bacteria reported here also suggests specificity of the inhibitor for levansucrase because the strain of B. circulans which was inhibited 100% produces only a levansucrase sucrolytic enzyme (Bugbee, unpublished). The low inhibition of B. subtilis and L. mesenteroides probably was due to the ability of these bacteria to produce more than one sucrase. Bacillus subtilis produces both dextansucrase and levansucrase and L. mesenteroides produces primarily dextansucrase. Levansucrase may be the primary sucrase produced by C. sepedonicum and C. nebraskense because these bacteria were inhibited 100 and 87% respectively.

The stability of the inhibitor to heat and its ability to function in a soil environment should enhance the possibility of a practical application of this material.

The Recovery of Corynebacterium sepedonicum from Sugarbeet.--The following research is being done in cooperation with Drs. Neil Gudmestad and Gary Secor, potato pathologists in the Department of Plant Pathology at North Dakota State University.--This research is being pursued with the objective of determining the role sugarbeets might play in the prevalence and severity of potato ring rot in the U.S. The potato ring rot bacterium was isolated from 6-week-old sugarbeet seedlings that had grown in nonsterile potting soil in the greenhouse. The roots were surface sterilized by sequential wash in detergent, 1% sodium hypochlorite, and flame-off of ethanol. The roots then were crushed and chopped in a small amount of sterile distilled water. Samples of the water were plated on nutrient agar. This procedure ensured that the root surface was sterile and that any bacteria that grew on the culture plates came from internal tissues of the seedlings. The sugarbeet strain was morphologically and serologically indistinquishable from a potato strain. Precipitation bands in double diffusion agar plates showed identical properties of antibodies from the potato and sugarbeet strains. The sugarbeet strain caused wilt of tomato and potato when inoculated onto roots. The bacterium was reisolated from wilted tomato, identified as C. sepedonicum, and caused wilt of tomato after injection into stems.

The bacterium also was isolated from internal tissues of surface sterilized sugarbeet roots that had grown in pastuerized soil that had been inoculated with ring rot potatoes.

A field grown sugarbeet was submerged in water for three days to initiate fermentation and deterioration on the theory that the population of C. sepedonicum would increase along with other bacteria. This root was homogenized and mixed with pastuerized soil to which then was transplanted tomato seedlings. The bacterium was isolated from tomatoes that developed wilt.

This research has shown that the sugarbeet can serve as a symptomless host of the ring rot bacterium under greenhouse conditions. Attempts failed to isolate the bacterium from roots collected from random fields this past growing season. The difficulty probably arose from the very low concentration of bacteria in healthy roots. Currently we are assaying bacterial pellets that have been obtained by centrifuging aqueous extracts from roots. This will increase the sensitivity of the test. The pellets will be assayed for C. sepedonicum using monoclonal antibodies made against cell wall components of the bacterium. The monoclonal antibodies are being supplied by Drs. S. H. DeBoer, Vancouver, British Columbia. Partial evidence to date suggest that the ring rot bacterium also is present in field grown sugarbeets that were collected near potato fields in the Red River Valley.

Publications

Bugbee, W. M. 1984. Partial purification and characterization of an invertase from Pseudomonas fluorescens. Can. J. Microbiol. 30: 1326-1329.

Jacobs, M. J., W. M. Bugbee, and D. A. Gabrielson. 1984. Characterization and relationship of bacteria associated with sugarbeet (Beta vulgaris L.) root tissue. North Dakota Academy of Science.

Bugbee, W. M., N. C. Gudmestad, G. A. Secor, and P. Nolte. 1984. Recovery of Corynebacterium sepedonicum from sugarbeet. Plant Disease 68: 1099. (Disease Notes)

PHYSIOLOGICAL SELECTION

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Past research has focused on the effects of cell size and cell division rate on sucrose concentration and root yield. Emphasis has shifted to applied selection procedures that apply selection pressure at the cellular level. Several selection approaches to identify genotypes with small cells and rapid cell division potential in the seedling stage have been studied. Several have shown moderate success; however, none have shown consistent enough results to recommend. This past year additional seedling selection methods were tested in replicated field trials.

The results are reported in Table 1. The low and high percent fiber selections from population m54 were the reverse of what was expected, i.e., the low percent fiber selection gave a higher and the high percent fiber selection gave a lower sucrose concentration than the parent. Differences were nonsignificant. The high percent dry matter selection was also lower than its parent. In the h537 population, the high percent fiber and high percent dry matter selections were not different from the parent. Only where the two parameters were combined did the selections exceed the parents in sucrose percentage. It appears that the environmental variation is too great to identify true differences in cell size when using just one of the selection parameters. Some inbreeding depression was observed which resulted in reduced yields. Crossing with male sterile testers restored this inbreeding depression (data not shown).

Table 1. Sucrose concentration and root and gross sugar yields for seedling percent fiber and percent dry weight selections and their respective parent populations.

	Sucrose %	Root Yield t/ha	Gross Sugar kg/na
m54 (Parent)	16.1	23.2	3750
Low % Fiber Sel	16.5	22.2	3572
High % Fiber Sel	15.7	20.6	3244
High % Dry Wt Sel	15.6	21.3	3315
High % Dry Wt + % F Sel	16.5	22.9	3807
LSD 0.05	0.7	3.3	597
h537 (Parent)	17.0	26.7	4536
High % Fiber Sel	17.1	20.2	3460
High % Dry Wt Sel	17.1	21.8	3745
High % Dry Wt + % F Sel	17.6	19.1	3347
LSD 0.05	0.7	3.6	694

Another approach has been to measure root yield and sucrose concentration in young plants five to six weeks of age grown under controlled greenhouse conditions. Sucrose concentrations are low in these young plants. Our tests were to determine if relative differences in sucrose content and yield in these young plants were indicative of their true differences under field conditions. Progeny tests for root yield and sucrose concentration in young plants were conducted in paired crosses of two populations. Since there were insufficient seed in any one paired cross for field testing, paired crosses with like progeny tests results were combined for field testing.

The results are recorded in Table 2. In both cases where strong selection pressure was applied for high percent sugar a higher sugar concentration was obtained; however, a corresponding lower root yield also resulted. Where strong selection pressure was applied for root yield a significant increase in root yield was achieved. These results indicate that the measurement of these parameters in young plants gives good agreement to their true yielding ability. It also points out the difficulty of combining these two parameters.

Table 2. Sucrose concentration and root and gross sugar yields for selections based on paired cross % sucrose and root yield performance and their respective parent populations.

	Sucrose %	Root Yield t/ha	Gross Sugar kg/ha
1303 (Parent)	17.6	28.0	4957
High % S - Med. Root Wt.	18.1	24.9	4537
Med % S - High Root Wt.	17.3	32.0	5558
LSD 0.05	0.8	3.9	774
g241 (Parent)	12.6	52.9	6700
High % S - Med. Root Wt.	13.9	47.3	6560
LSD 0.05	0.8	6.9	1005

RESPIRATION EFFICIENCY

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We have previously reported that respiration efficiency appeared to be a limiting factor in growth and hybrid vigor and had more influence on these factors than photosynthesis. These findings were obtained from mitochondrial respiration measurements and whole beet storage respiration data. These techniques are very sophisticated and not of practical application. This past year's studies involved efforts to develop more practical ways of measuring relative respiration efficiency.

The approach was to eliminate photosynthesis and measure the efficiency with which cultivars produce new growth in the absence of photosynthesis. The procedure was as follows: Plants are grown in the greenhouse to about the 1.0 to 2.0 cm in diameter size. All leaves except the center rosette are trimmed and the plants covered with dark plastic to eliminate photosynthesis. Proper moisture and temperature are maintained to force the plants to produce new leaves from their stored photosynthate. By determining the amount of stored photosynthate before and after regrowth and the amount of regrowth, the relative respiration efficiency can be estimated.

Measuring the stored photosynthate destroyed the plants; therefore, large cultivar populations had to be grown so that samples drawn from each cultivar population for determinations prior to regrowth truly represented that cultivar population mean. Originally sucrose concentrations were measured by the saccharimeter method. However, the small root size and low sucrose concentrations made it difficult to make good definitive determinations. In addition, other photosynthates other than sucrose may be utilized for regrowth. It was, therefore, decided to measure total dry matter as a measure of stored photosynthate.

Three tests were conducted with seven cultivars varying in known root yield potential (Table 1). The data in Table 1 are for the relative efficiency of each cultivar to produce regrowth from their respective stored reserves, based on total dry matter. In three cases this efficiency was greater than 100% suggesting that there was an error in sampling that population. Generally, the efficiencies ranged in similar descending order of root yield potential. However, differences were small and there were sufficient irregularities to suggest that these data did not represent real efficiency measurements or that our original assumptions were incorrect.

It was noted that the cultivars used had big differences in partitioning between the root and top (Table 2). These differences in partitioning are evident in Test 4 (Table 2). The highest root yielding cultivars had the smallest tops and the smallest root yielding cultivars had the largest tops. This resulted in very little difference in total dry weight production between the seven cultivars and may explain some of the problems we encountered in attempting to measure relative respiration efficiency. Test

Table 1. Respiration efficiency measured as regrowth in the absence of light per photosynthate (dry matter) utilized for seven cultivars.

	Test 3	Test 4	Test 5	Mean
Hilleshog 833	96	94	92	94
GW 149	91	80	91	87
USH 11	104*	85	99	92
Beta 9421	89	92	142*	90
Barsein	68	92	98	86
US22/3	98	78	83	86
L19	123*	93	92	93

* = Sampling error.

five was not as discreet in identifying partitioning differences; however, their relationship with each other was similar and the plants were much smaller.

Table 2. Top, root and total dry weights for seven cultivars at 35-42 days.

	Test 4 (dry wts)			Test 5 (dry wts)		
	Top	Root	Total	Top	Root	Total
	g	g	g	g	g	g
Hilleshog 833	1.83	1.51	3.34	1.00	0.59	1.59
GW 149	2.23	1.12	3.35	1.04	0.39	1.43
USH 11	2.22	1.01	3.23	1.03	0.41	1.44
Beta 9421	2.28	0.83	3.11	0.86	0.24	1.10
Barsien	2.03	0.92	2.95	0.75	0.32	1.07
US22/3	2.49	0.88	3.37	0.95	0.30	1.25
L19	1.95	0.98	2.93	0.82	0.35	1.17
LSD 0.05	0.24	0.22	0.32	0.15	0.10	0.23

If relative respiration efficiency is a major limiting factor for regrowth, then a more simple and practical measure might be the total dry weight of the root after regrowth. Those cultivars with the greatest efficiency would lose the least stored photosynthate for regrowth and differences should therefore be widened, i.e., if environmental variables are controlled during growth. Tables 3 and 4 give the root dry weight and total plant dry weight after regrowth for the seven cultivars. The root dry weights and the total plant dry weights are very similar. In every test the Hilleshog 833 cultivar gave a significantly higher root yield than

the other cultivars. The ranking of the cultivars over tests were relatively consistent. There were few significant differences between the remaining cultivars. We will continue to evaluate and test for respiration efficiency as a major growth variant as our research facilities are improved.

Table 3. Root dry weights after regrowth for seven cultivars.

	Root Dry Weights After Regrowth			
	Test 3	Test 4	Test 5	Mean
	g	g	g	g
Hilleshog 833	0.86 a*	1.26 a	0.42 a	0.85 a
GW 149	0.56 b	0.70 b	0.33 b	0.53 b
USH 11	0.51 b	0.83 b	0.31 b	0.55 b
Beta 9421	0.36 c	0.71 b	0.33 b	0.46 b
Barsein	0.38 c	0.73 b	0.29 bc	0.46 b
US22/3	0.47 bc	0.63 b	0.23 c	0.44 b
L19	0.51 b	0.85 b	0.28 bc	0.55 b

*Means followed by the same letter are not different at the 0.05 probability level.

Table 4. Total plant dry weight after regrowth for seven cultivars.

	Total plant dry weights after regrowth			
	Test 3	Test 4	Test 5	Mean
	g	g	g	g
Hilleshog 833	1.02 a*	1.49 a	0.47 a	0.99 a
GW 149	0.75 b	0.86 bc	0.35 b	0.65 b
USH 11	0.63 bc	0.97 bc	0.33 b	0.64 b
Beta 9421	0.47 c	0.85 bc	0.35 b	0.56 b
Barsien	0.47 c	0.88 bc	0.31 bc	0.55 b
US22/3	0.62 bc	0.77 c	0.25 c	0.54 b
L19	0.64 b	1.02 b	0.32 bc	0.66 b

*Means followed by the same letter are not different at the 0.05 probability level.

BARE ROOT TRANSPLANTING

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A number of years ago we tested the feasibility of transplanting using the Japanese paper pot method. These tests were conducted for three years and the results published in the Journal of ASSBT 20:503-516. In these tests increases in yield were obtained; however, these increases were insufficient to cover the increased cost of transplanting. There was also the need to irrigate immediately following transplanting.

This past year's test was a different approach to transplanting. Once the sugarbeet root forms its complete set of rings or when it reaches 0.5 to 1.0 cm in diameter, it can take a lot of abuse and can be readily transplanted. When using the Japanese transplanting method the leaves are larger than the root, difficult to handle and oftentimes die, afterwhich the plant produces new leaves. We reasoned that if the roots were large enough (0.5 - 1.0 cm) to survive without leaves they could be transplanted more easily, be more reliable, be less costly and be more productive than the Japanese method. The idea is to grow the plants in a southern location in the early spring at very high densities. When the plants are about 0.5 to 1.0 cm in diameter the tops can be trimmed off and the plants dug and bundled for shipping to northern locations in time for planting.

To test this approach we planted seed of the commercial hybrid Hilleshog 833 in small containers (100/2-square-foot container) in the greenhouse in early March. On May 11 the leaves were trimmed to about 1 cm above the crown and the roots pulled, stripping off all the fibrous roots. These were transplanted and seed of Hilleshog 833 planted in a randomized block design with eight replications. Plots were four rows, 30 feet in length. Transplants were spaced at one foot intervals and the direct seeded plots thinned to one foot spacings at the four true leaf stage. Transplants were about 1 cm in diameter at the time of transplanting. At harvest time (September 21), the two center rows of each plot were dug, weighed and analyzed for sucrose content.

Results are given in Table 1. The direct seeded plots had a slightly higher but nonsignificant sucrose percentage than the transplanted plots. The transplanted plots yielded a highly significant 12.8 tons/ha (5.7 tons/acre) more than the direct seeded plots. This resulted in a significant increase in gross sugar for the transplants. There was no difference in nitrogen concentration. This 20 percent increase in sugar production is greater than experienced with the Japanese paper pot method and warrants a more critical evaluation.

Table 1. Sugar percent, root yield, gross sugar and nitrogen for transplanted and direct seeded beets of hybrid Hilleshog 833.

	Sugar %	Root Yield t/ha	Gross Sugar kg/ha	Nitrogen ppm
Transplanted	15.57	68.1	10607	736
Direct Seeded	15.79	55.3	8720	709
LSD 0.05	0.34	8.0	1220	80
CV	1.6%	9.9%	9.9%	9.2%
F Ratio	1.9^{ns}	12.6^{**}	12.5^{**}	0.6^{ns}

**Significant at p = 0.01.

EVALUATION OF *BETA* GERMPLASM

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At the February 1983 meeting of the Sugarbeet Crop Advisory Committee (CAC), a list of germplasm descriptors was developed for *Beta* germplasm and a proposal made for the evaluation of the *Beta* germplasm now contained in the NC7 collection at Ames, Iowa. Subsequent funding for these evaluations has not been obtained; however, a cooperative evaluation effort between ARS at Fargo, ND, and American Crystal Sugar Company at Moorhead, MN, was established this past year.

A number of the accessions in the NC7 collection have small quantities of original seed. Seed increases of this original seed are being produced by both public and private volunteers. Evaluations will, therefore, not be made on these accessions until sufficient quantities of seed can be produced from the original seed. The remaining accessions in the NC7 collection have been increased several times since their inclusion in the collection. Most increases were not in controlled isolation conditions; hence, some mixing of germplasm has occurred. It was decided that some evaluation was necessary prior to seed increase to ascertain the degree of germplasm mixing. In some cases simple roguing may be sufficient to purify the germplasm.

Seed of 28 lines of the NC7 collection that did not have any original seed but had been increased several times was obtained. In each case seed was from the earliest increase in which there was sufficient seed for evaluation. Seed germination was determined by American Crystal prior to planting. Two separate trials were planted May 14, 1984, on American Crystal research land. One trial was a replicated field experiment of five replications. Some of the entries had insufficient seed for all five reps. This resulted in a randomized augmented block design of single row plots. The remaining seed was planted in an observation trial for horticultural evaluation, roguing and mother root selection for seed increase. The number of rows for each accession ranged from two to eight. Both trials were thinned to nine-inch spacings at about the four true-leaf stage.

Some bolting occurred in many of the lines even though they had been classed as biennial. In the replicated trial, the bolters were cut and not allowed to flower. The bolting plants in the observation plot were removed and transplanted in an isolation plot for seed increase. Transplanting set these plants back; however, most survived and continued bolting. Unfortunately, few produced seed. The delay in bolting caused by transplanting delayed seed production and most plants were flowering at the time of the first killing frost.

Evaluations of the above ground plant parts were made throughout the growing season. Roguing of obvious mixtures was also conducted throughout the season. Many lines appeared to be segregating for a number of characters and no one segregate represented a line. In these lines, it was decided that it was best to report the segregating that was occurring within the line as representative of the line and to select sufficient roots for seed increase to maintain the apparent segregates. Mother roots were saved from all lines and stored in photo-thermal induction rooms for seed production in 1985.

The replicated trial was harvested September 18. Sugar and impurity analyses were conducted by the American Crystal research tare lab. The data and evaluation information are tabulated in Table 1, following the CAC approved descriptor list. Where the evaluation is for a specific character, the entry in the table is the numerical number that represents that character. Table 2 gives a description of the used characters. Segregating lines are identified by more than one entry and in some cases having a range of entries for that characteristic.

These 28 lines had a wide range of colors, types and shapes. Most were fodder types and had a lower sugar and higher root yield than the check varieties. The check varieties included in the replicated trial were Ultramono, SP 7622-0 MM, and L19.

Table 1. Field and laboratory evolution for 26 accessions from the Ames, Iowa collection. Evaluations were made in Moorhead, Minnesota, 1984.

	End Use	Growth Habit	Plant Height (cm)	Plant Diam. (cm)	Leaf Erectness	Leaf Blade Pigment	Leaf Hairiness	Leaf Thickness	Petiole Length (cm)	Petiole Width (cm)	Blade Length (cm)	Leaf Blade Width (cm)	Petiole Color
	1.0	6.0	7.0	8.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0
PI 109039	1.2	6.3	30	63	11.5	12.3	13.1	14.5	21	1.1	18	12.8	19.3
PI 116906	1.2	6.2	38	52	11.3-11.8	12.1-12.4	13.0	14.5-14.7	24	1.4	22	13.6	19.3-19.4
PI 117114	1.4	6.2	32	81	11.4-11.8	12.1-12.4	13.0	14.5	31	1.7	19	11.5	19.1-19.4
PI 117117	1.5	6.1	43	80	11.9	12.2	13.0	14.6	25	2.2	26	15.2	19.1
PI 120689	1.4	6.1	50	60	11.8+11.9	12.2	13.1	14.5-14.6	18	1.3	25	16.2	19.1
PI 120691	1.4	6.1	46	71	11.5-11.9	12.2	13.0	14.5	22	1.3	21	14.8	19.1
PI 120693	1.4	6.2	43	79	11.5-11.8	12.2	13.0-13.6	14.5	16	1.8	32	18.0	19.1
PI 120697	1.4	6.2	23	53	11.5-11.8	12.2+12.3	13.0-13.1	14.5	16	1.1	19	6.6	19.1-19.3
PI 120698	1.4	6.3	33	69	11.7	12.2	13.0	14.5	24	1.4	23	12.4	19.1+19.5
PI 120707	1.4	6.4	22	54	11.3-11.8	12.2-12.4	13.0-13.7	14.5-14.6	18	1.4	21	11.0	19.3+19.4
PI 140351	1.7	6.4	20	66	11.3-11.6	12.1-12.3	13.0	14.4	20	1.2	21	13.4	19.1-19.3
PI 140360	1.4	6.2	26	65	11.8	12.1-12.4	13.0	14.5	21	1.5	20	15.4	19.1-19.3
PI 141918	1.4	6.4	27	66	11.3-11.6	12.2-12.3	13.1	14.4	21	1.0	18	10.4	19.1-19.3
PI 142821	1.4	6.1	43	70	11.7-11.9	12.2	13.1	14.5	30	1.3	22	14.6	19.1+19.2
PI 142823	1.4	6.3	32	75	11.4	12.2-12.3	13.4	14.6	16	1.5	18	13.8	19.1-19.4
PI 144675	1.2	6.1	54	72	11.8-11.9	12.1-12.3	13.1-13.2	14.5+14.6	27	1.7	30	20.2	19.1-19.3
PI 164292	1.2	6.3	26	51	11.5	12.3+12.4	13.0	14.6	23	0.7	18	12.0	19.3+19.4
PI 165062	1.5	6.2	39	68	11.5	12.1	13.2	14.5	20	1.5	19	14.2	19.1
PI 169017	1.4	6.2	34	65	11.5	12.1	13.1	14.5	22	1.1	22	20.0	19.1+19.2
PI 169018	1.5	6.1	37	81	11.8	12.1	13.0	14.4	30	1.6	22	13.6	19.1
PI 169019	1.1	6.2	42	47	11.8	12.3	13.1	14.5	27	1.3	22	15.0	19.3
PI 171517	1.5	6.2	42	75	11.9	12.2	13.1	14.5	29	1.5	27	16.5	19.1+19.5
PI 171520	1.4	6.2	36	68	11.3-11.8	12.2	13.2	14.5	26	1.8	23	12.0	19.1+19.2
PI 172730	1.4	6.3	24	66	11.3	12.3	13.1	14.6	20	1.1	18	13.2	19.1-19.3
PI 173642	1.4	6.2	29	79	11.3-11.5	12.1-12.3	13.1	14.4	22	1.4	23	17.8	19.1+19.2
PI 184060	1.4+ 1.5	6.1	46	70	11.9	12.1	13.0	14.6	20	2.2	27	18.0	19.1

Table 1 Continued

	Root Position	External Root Color	Main Color of Flesh	Crown Width (cm)	Crown Height (cm)	Ring Color of Flesh	Root Shape Longitude	Root Length (cm)	Root Width (cm)	Root Division
	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
PI 109039	21.2	22.4	23.4	1.0-4.0	2.5-5.0	26.1-26.4	27.3+27.5	12-39	4.2-12.5	30.1
PI 116906	21.2-12.5	22.3+22.4	23.1-23.4	2.0-4.0	1.0-5.0	26.1-26.4	27.4	28-63	4.0-12.0	30.1+30.2
PI 117114	21.2-21.5	22.3+22.4	23.1-23.4	1.0-8.0	1.0-3.0	26.1	27.3+27.4	14-37	5.0-14.0	30.1
PI 117117	21.5	22.1	23.1	4.0-7.0	2.0-6.0	26.1	27.4	25-40	7.5-11.0	30.1+30.2
PI 120689	21.2	22.3	23.1	5.0-8.0	2.0-5.0	26.1	27.3	30-40	9.0-18.5	30.1
PI 120691	21.4+21.5	22.1-22.4	23.1	3.5-6.0	1.0-5.0	26.1	27.3,27.4,27.6	25-60	5.5-13.0	30.1+30.3
PI 120693	21.4+21.5	22.3	23.1	3.0-7.0	3.0-8.0	26.1-26.3	27.2+27.5	20-50	5.0-16.0	30.1+30.3
PI 120697	21.4+21.5	22.1-22.4	23.1	2.0-7.0	1.0-3.0	26.1	27.2+27.6	24-60	4.0-11.0	30.1+30.3
PI 120698	21.2	22.3-22.4	23.1+23.2	2.0-6.0	2.0	26.1+26.2	27.2+27.4	30-50	5.0-13.0	30.1
PI 120707	21.2	22.4	23.1+23.4	1.5-6.0	2.0-5.0	26.1,26.3, 26.4	27.5+27.6	23-53	4.5-13.0	30.1
PI 140351	21.2+22.5	22.1-21.3	23.1	2.5-5.5	2.0-5.0	26.1+26.4	27.2+27.5	20-49	4.0-14.0	30.1+30.2
PI 140360	21.3+21.4	22.1,22.3,22.4	23.1,23.2,23.4	1.5-7.0	2.0-5.0	26.1+26.4	27.2+27.3	12-45	5.0-13.0	30.1
PI 141918	21.3+21.4	22.1,22.3,23.4	23.1+23.4	1.0-5.0	1.0-5.0	26.1+26.4	27.2+27.4	12-63	3.0-13.0	30.1
PI 142821	21.3+21.4	22.1-22.5	23.1	1.5-2.8	1.0-5.0	26.1+26.4	27.1+27.4	10-40	4.0-16.0	30.1+30.2
PI 142823	21.5	22.4	23.1	1.0-9.0	1.0-3.5	26.1+26.4	27.1+27.2	12-35	3.5-13.5	30.1
PI 144675	21.3	22.4	23.1	2.0-6.5	0.5-3.0	26.4	27.1+27.2	14-30	5.0-17.0	30.1
PI 164292	21.2	22.4	23.4	0.5-2.0	0.5-2.0	26.3+26.4	27.3	15-30	5.5-13.7	30.1
PI 165062	21.5	22.1	23.1	2.0-8.0	1.0-4.0	26.1	27.4+27.5	15-54	2.7-13.0	30.1-30.2
PI 169017	23.1	22.1	23.1	2.0-7.0	3.0-5.0	26.1	27.3+27.4	14-45	5.0-11.0	30.1
PI 169018	21.4	22.0	23.1	3.0-8.0	2.0-7.0	26.1	27.4	18-50	4.0-11.0	30.1
PI 169019	21.4	22.4	23.4+23.5	7.0-8.0	1.0-5.0	26.1	27.3+27.6	14-41	2.0-13.0	30.1
PI 171517	21.4	22.1-22.3	23.1	6.0-14.0	1.5-5.5	26.1	27.4+27.6	17-45	2.5-14.7	30.1-30.3
PI 171520	21.5	22.1	23.1	3.0-6.5	1.0-3.0	26.1	27.4+27.6	19-53	3.5-11.0	30.1+30.2
PI 172730	21.6	22.3-22.4	23.1+23.4	3.0-9.0	1.0-4.0	26.1+26.4	27.3-27.6	13-50	4.0-15.0	30.1+30.2
PI 173642	21.3+21.6	22.1-22.5	23.1-23.4	4.0-7.0	0.5-5.0	26.1+26.4	27.2-27.5	22-53	5.0-13.0	30.1-30.3
PI 184060	21.5	22.1	23.1	4.0-7.0	2.0-3.0	26.1	27.4	30-44	7.0-10.0	30.3

Table 1 Continued.

	Suture Presence	Bolting Tendency	Sugar % Fr. Wt.	Sugar % check	Potassium	K/ sucrose	Sodium	Na/ Sucrose	α-Amino-N	α-Amino-N	Root Yield	Gross Sugar	Recoverable Sugar
		%			mg/L	me/100gs	mg/L	me/100gs	mg/L	me/100gs	t/ha	kg/ha	%
		31.0	37.0	38.0	39.0	41.0	42.0	43.0	44.0	45.0	46.0			
PI 109039	shallow 0-2	6	11.8	67	3320	72	980	36	760	36	29.8	3434	78
PI 116906	medium 2-3	47	11.3	64	3250	74	960	37	1060	53	38.2	4415	75
PI 117114	shallow 0-2	5	12.6	71	3390	69	690	24	990	44	44.8	5583	76
PI 117117	medium 2-3	7	12.8	73	2970	59	870	30	1050	37	42.6	5439	78
PI 120689	shallow 0-3	10	11.2	64	3740	86	740	29	1350	67	40.4	4591	70
PI 120691	deep 2-8	25	12.3	69	3191	66	890	32	1080	49	46.2	5693	76
PI 120693	deep shallow 0-3	79	12.5	71	3130	64	830	29	970	43	23.1	2879	78
PI 120697	shallow 0-3	68	12.2	69	2910	61	860	31	920	42	17.7	2164	79
PI 120698	very shallow 0-2	0	11.9	67	3660	79	770	28	1060	49	41.2	4883	75
PI 120707	med. shallow 0-4	8	11.2	64	3090	71	1130	44	930	45	34.5	3779	74
PI 140351	med. shallow 2	0	11.2	64	3290	75	1020	40	1060	52	52.0	5779	73
PI 140360	2-6	18	11.8	67	2950	64	980	36	1060	50	48.2	5589	76
PI 141918	shallow 0-4	3	12.5	71	3190	65	710	25	1190	53	40.8	5080	77
PI 142821	very shallow 0-2	1	11.2	64	3170	73	1070	42	1060	53	43.5	4858	73
PI 142823	0-1	18	11.8	66	3250	71	1000	37	1080	51	36.8	4260	74
PI 144675	0-2	6	11.6	66	3350	74	790	30	960	46	44.8	5153	76
PI 164292	0	3	14.7	82	2490	43	740	22	550	21	22.9	3350	83
PI 165062	medium 2-4	10	13.3	75	2870	55	810	26	970	40	39.7	5263	80
PI 169017	smooth 0-2	0	13.7	78	3340	63	730	23	800	32	48.4	6374	80
PI 169018	medium 2-4	0	15.7	89	2680	44	820	23	970	34	37.2	5788	83
PI 169019	very shallow 0-4	1	12.8	71	3040	61	710	24	890	39	29.2	3727	80
PI 171517	shallow 0-2	41	12.1	69	2960	63	720	26	1100	50	33.4	4107	77
PI 171520	medium 1-4	33	12.8	93	2940	59	770	26	990	43	38.6	4942	79
PI 172730	very shallow 0-5	0	13.2	75	3390	66	790	26	1110	47	33.2	4272	76
PI 173642	medium 0-4	64	11.7	66	3120	68	920	34	1010	48	32.5	3778	76
PI 184060	3-4	59	-	-	-	-	-	-	-	-	-	-	-
Check mean			17.6	-	2320	34	540	13	820	26	32.2	5720	
LSD 0.05			0.7	4	210	-	180	-	70	-	6.6	863	

Table 2. Germplasm Descriptors Used.

1.0 = End Use
- 1.1 = Leaf Vegetable
- 1.2 = Root Vegetable
- 1.3 = Leaf & Root Vegetable
- 1.4 = Fodder
- 1.5 = Sugar Extraction
- 1.7 = Unknown

6.0 = Growth Habit
- 6.1 = Erect
- 6.2 = Erect and Procumbent
- 6.3 = Procumbent
- 6.4 = Erect and Prostrate

11.0 = Leaf Erectness (0-9)
- 11.0 = Absence of Rosette
- 11.1 = Prostrate
- 11.9 = Erect

12.0 = Leaf Blade Pigment
- 12.1 = Light Green
- 12.2 = Green
- 12.3 = Green-Red Mixture
- 12.4 = Red

13.0 = Leaf Hairness (0-7)
- 13.0 = Hairs Absent
- 13.3 = Hairs Present
- 13.5 = Hairy
- 13.7 = Very Hairy

14.0 = Leaf Thickness
- 14.3 = Thin
- 14.5 = Medium
- 14.7 = Thick

19.0 = Petiole Color
- 19.1 = Green
- 19.2 = Pink
- 19.3 = Red
- 19.4 = Mixed

21.0 = Root Position
- 21.1 = Very Shallow
- 21.2 = Shallow
- 21.5 = Medium
- 21.7 = Deep
- 21.9 = Very Deep

22.0 = External Root Color
- 22.1 = White
- 22.2 = Yellow
- 22.3 = Orange
- 22.4 = Red
- 22.5 = Dark [illegible]

23.0 = Main Color of Flesh
- 23.1 = White
- 23.2 = Yellow
- 23.3 = Orange
- 23.4 = Red

26.0 = Ring Color to Flesh
- 26.1 = White
- 26.2 = Yellow
- 26.3 = Orange
- 26.4 = Red

27.0 = Root Shape
- 27.1 = Narrow Elliptic
- 27.2 = Elliptic
- 27.3 = Circular
- 27.4 = Broad Elliptic
- 27.5 = Narrow Oblong
- 27.6 = Narrow Ob-Triangular

30.0 = Root Division
- 30.1 = Single
- 30.2 = Fanged
- 30.3 = Very Fanged

31.0 = Suture Presence (1-9)
- 31.1 = No Sutures
- 31.9 = Many Sutures

EFFECT OF VARIETIES AND FUNGICIDES ON SUCROSE LOSSES DURING POST-HARVEST STORAGE

D. F. Cole, A. W. Cattanach, and L. J. Smith

The objectives of these experiments were to determine the effect of cercospora resistant and susceptible varieties and different fungicides on post-harvest sucrose losses. Sugarbeet roots were collected from three experiments conducted in 1982 and 1983 at Murdock and Moorhead, Minnesota. The roots were mechanically harvested, washed, and stored in perforated plastic bags at 40 F for 120 days after harvest. Recoverable sucrose per ton was determined before and after storage.

Data from the three experiments were combined. Significant differences in recoverable sucrose per ton (RSPT) were observed before and after storage (Fig. 1) among the varieties and fungicide treatments. The highest RSPT was found in beets that had been sprayed with TPTH and a mixture of TPTH + TBZ. ACH-14 had the highest RSPT before and after storage. A significant variety x fungicide interaction indicated that Hilleshog 309 sprayed with TBZ lost the most RSPT during storage (Fig. 2). These data indicate that storage losses are increased when the plants are sprayed with TBZ during the growing season. Also, cercospora susceptible varieties had the largest losses of RSPT during post-harvest storage.

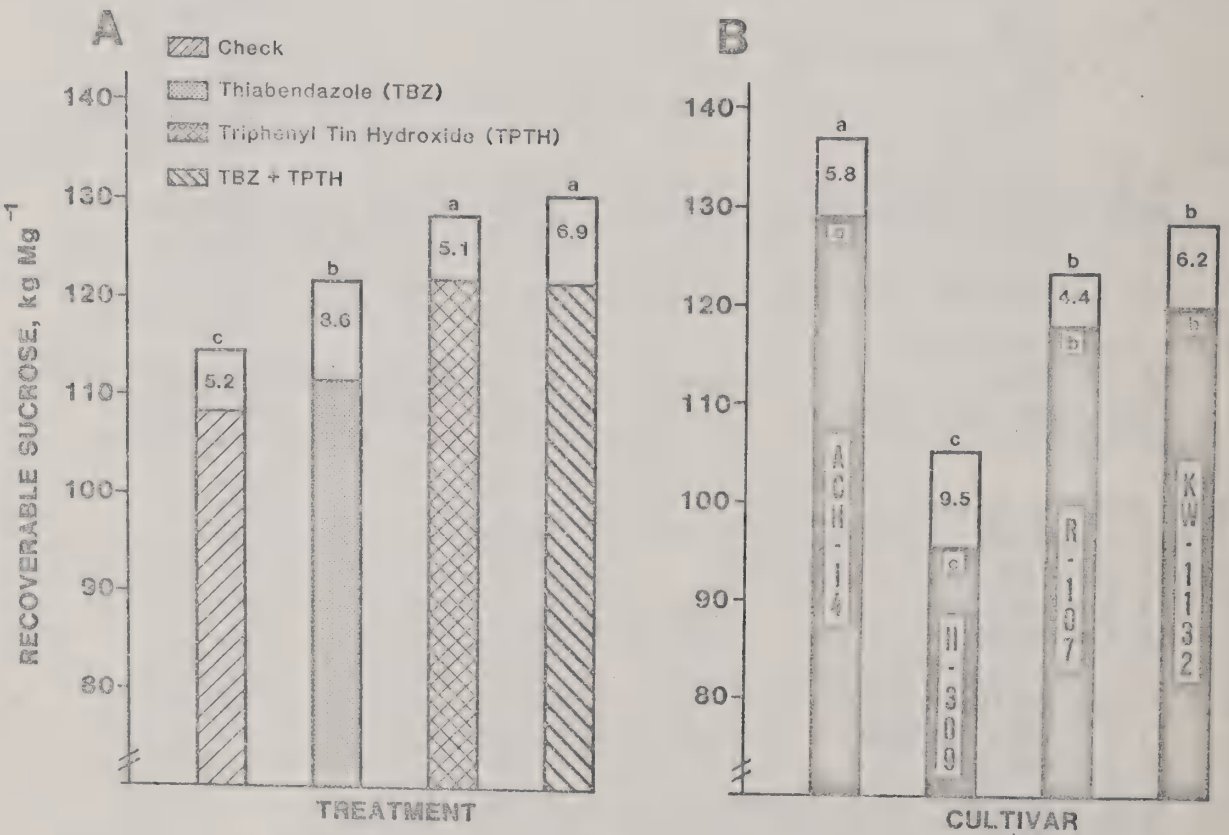

Fig. 1. Effects of varieties and fungicides on recoverable sucrose per ton (RSPT). Letters above and in the bars represent the Duncan's Multiple Range Test at harvest and after storage, respectively. The numbers in bars indicate the percent loss of RSPT during storage.

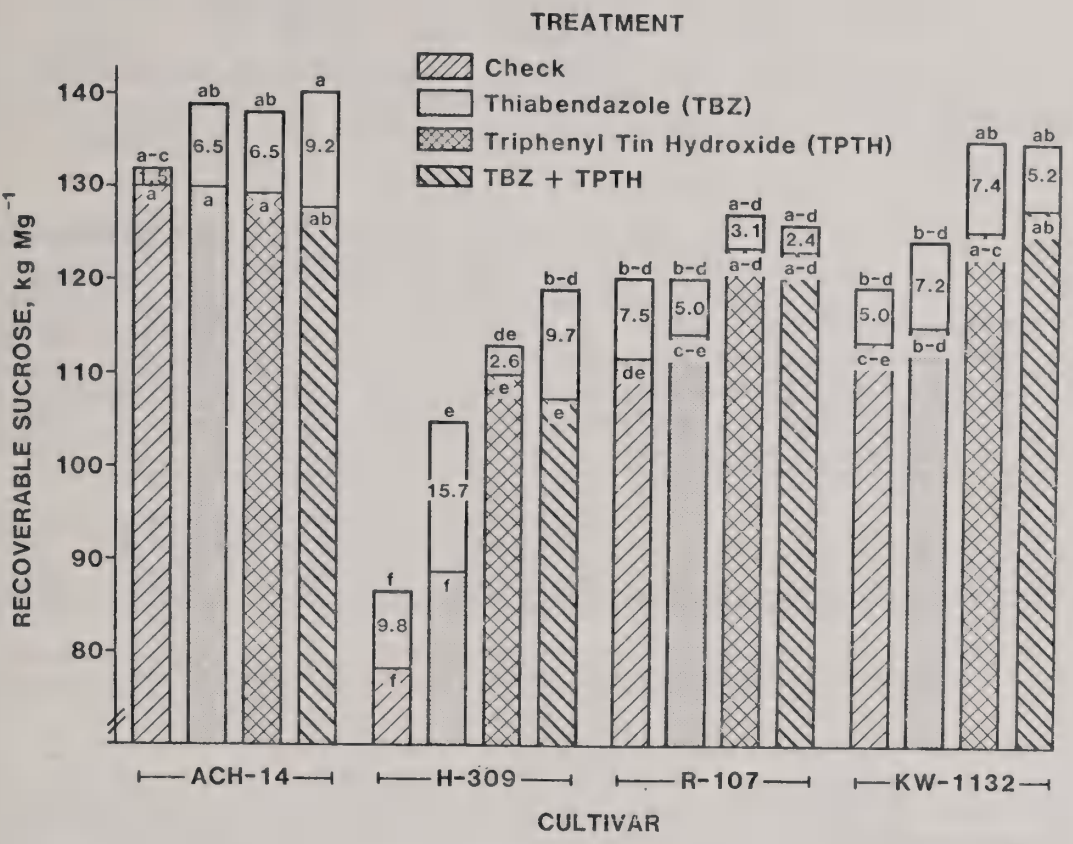

Fig. 2. The effect of the variety x fungicide interaction on recoverable sucrose per ton (RSPT) before and after storage. Letters above and in the bars represent the Duncan's Multiple Range Test at harvest and after storage, respectively. The numbers in bars indicate the percent loss of RSPT during storage.

Genetic Analysis of Internal CO_2

A study was initiated to compare the internal CO_2 levels for various inbreds and their hybrids with low and high internal CO_2 lines and a commercial hybrid. A secondary objective was to determine the type of genetic variance associated with internal CO_2.

Seed of 2 female and 5 male inbreds, 10 hybrids, low and high internal CO_2 lines, and a commercial hybrid were planted in 1-row plots 4.5 m long. Nine replications in a split-plot design with sample date as main plots and entries as sub-plots were used in this study. Weeds were controlled with pre-plant and post-emergence chemicals at recommended rates.

Three to five roots were selected from each plot at harvest, washed and placed into perforated plastic bags at 5 C. Roots from half of the plots were cored and plugged with a serum stopper 2 days after harvest. The remaining roots were cored 30 days after harvest. Internal CO_2 was determined 2 days after the roots were plugged.

Seed of two lines, L33 CMS and E1, did not emerge due to poor seed quality. One hybrid, L33 CMS x E1, bolted during the growing season and no roots were harvested. The other inbreds produced small roots and some were not suited for the determination of internal CO_2. Most of the hybrids and the low and high lines produced average size roots even though the growing season was abnormal due to no rain during the months of July, August, and most of September.

Analysis of the data indicated that there were significant differences in internal CO_2 among all entries at harvest and after storage (Table 1). The high CO_2 line was the highest at harvest and after storage. Significant differences were observed among the males at harvest and after storage and among the females after storage (Table 2). Because of poor stands and lack of rainfall, the data obtained this year should be interpreted with caution. Additional data with good quality roots is needed before conclusions about the genetic variance can be drawn.

Table 1. Internal CO_2 of various sugarbeet genotypes at harvest and after 30 days storage at 5 C.

Entry	Description	Internal CO_2, %	
		Harvest	Storage
2	L53 CMS	1.2	1.0
3	A1	0.9	1.1
4	A4	1.1	1.2
5	A5	1.2	1.4
7	F4	1.5	1.3
8	L33 CMS x A1	0.9	0.9
9	L33 CMS x A4	1.1	1.1
10	L33 CMS x A5	1.2	1.2
12	L33 CMS x F4	1.6	1.4
13	L53 CMS x A1	1.1	1.0
14	L53 CMS x A4	1.1	1.0
15	L53 CMS x A5	1.3	1.1
16	L53 CMS x E1	1.2	1.1
17	L53 CMS x F4	1.3	1.2
18	F1003 (Low CO_2 line)	1.0	0.8
19	High CO_2 line	2.0	1.8
20	BETA-6264	1.3	1.2

Table 2. Analysis of variance summary for males and females used in the internal CO_2 study.

Source of Variation	Lf	Harvest		Storage	
		ns	f	ns	g
Females	1	.021	0.3	0.249	4.7*
Males	3	3.107	44.4**	1.766	33.1**
Females x males	3	0.832	11.9**	0.369	6.9**
Residual	319	0.070			

* Significant at 0.05 level
** Significant at 0.01 level

Internal CO_2 of Sugarbeet Roots from the Coded Cultivar Test

Sugarbeet roots of several commercial cultivars were manually harvested from six locations in the Red River Valley in late September of 1984. The roots were washed and stored at 5 C and near 100% relative humidity for 35 days. Five days after harvest, a core of tissue was removed from the roots, 4 cm below the lowest leaf scar, and the cavity was sealed with a serum stopper. A sample of gas was removed from the sealed cavity at 7 and 35 days after harvest. An infrared gas analyzer was used to determine the amount of carbon dioxide (CO_2)in the sample.

The results indicated that significant differences were detected in internal CO_2 7 days after harvest but not after 35 days (Table 3). No differences were detected among location at 7 days; however, significant differences were detected at 35 days.

Table 3. Internal CO_2 levels of 11 commercial cultivars at 7 and 35 days after harvest. Roots stored at 5 C and near 100% humidity.

Cultivar	n	Days after Harvest	
		7	35
		%	
ACH-30	60	1.7	1.0
Puressa II	50	1.5	1.0
Monofort	60	1.5	1.0
KW 1132	60	1.5	1.0
B. J. 19	60	1.5	1.0
Ultramono	60	1.4	1.0
Monoricca	50	1.4	0.9
ACH-14	50	1.4	1.0
Beta 1237	60	1.4	0.9
Beta 1230	60	1.3	0.9
GW 107	60	1.2	1.0
LSD .05 (n = 60)		0.2	ns
LSD .05 (n = 50)		0.2	ns

HIGH SUGAR SELECTIONS FROM THE WORLD COLLECTION

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Successful plant breeding programs depend upon a constant influx of new germplasms. To facilitate this process the world collection of Beta vulgaris was screened with the intent of isolating relatively high sugar lines that would eventually provide commercial breeders with some diverse germplasm for incorporation into their hybrid development programs. In 1980 all available entries in the world collections were examined. The sucrose content of individual roots were measured on a sample obtained by drilling a 1¼-inch hole in the taproot with a power drill. Individual roots with high levels of sucrose from entries with relatively high plot means (compared to adjacent checks) were increased by crossing selected plants in pairs. Progeny from each cross were evaluated in replicated trials in 1981. Superior individuals from the higher sugar lines were crossed in pairs again for evaluation in 1982. Lines that performed well in 1982 were increased for evaluation in 1983 and 1984. Table 1 summarizes the performance of lines presently in the program. Most lines have sucrose contents at least equal to the check hybrids. The negative association between root yield and sucrose content often encountered in sugarbeet production and breeding has not been overcome, although some attention was given to root yield during the selection cycles. Root yields below the commercial hybrids were not unexpected because of the inbreeding that accompanied selection and because selection was primarily for sucrose content. The data indicates that selection for sucrose content will result in acceptable purity levels.

In addition to the above material, high sucrose individuals from 30 lines representing 7 countries (Turkey, U.S.S.R., Poland, Iran, Ethiopia, Afghanistan, and Burma) were interpollinated in 1980. Each plant was harvested separately and the progeny evaluated as half-sib families in 1982. This process was repeated in 1983. Table 2 summarizes the performance of the 55 half-sib families evaluated in 1984. The data indicate progress in selecting for sucrose content and suggest that yield levels have not been drastically reduced. An effort has been made to maintain the genetic diversity in this material.

These lines will not only provide germplasm for the development of high sucrose parental lines but will also provide genetically diverse lines and populations for other breeding objectives.

Table 1. High sugar selections from world collection of Beta vulgaris; expressed as a % of check means, 1983-84, Fargo, North Dakota.

PI Number	Country of Origin	Sucrose %	Root Yield	Purity
PI251042/PI142813	Yugoslavia - Iran	120	33	103
PI266100	Poland	118	56	103
PI266100	Poland	106	60	98
PI355965	U.S.S.R.	105	88	101
PI266102/PI220645/ PI169025/PI164987	Poland - Turkey(2) - Afghanistan	104	80	98
PI251042/PI142813	Yugoslavia - Iran	103	71	101
PI355965	U.S.S.R.	103	59	101
PI169025	Turkey	106	73	98
PI142813	Iran	102	84	99
PI355959	U.S.S.R.	96	82	98
PI140359	Iran	102	82	100
PI140356	Iran	100	78	99
PI355959	U.S.S.R.	99	68	100
PI355965	U.S.S.R.	93	74	100
PI355958/PI169025	U.S.S.R. - Turkey	99	66	100
Hilleshog 833		102	106	101
Ultramono		101	95	99
Beta 1443		97	99	100

Table 2. Means and ranges of 55 half-sib families; expressed as % of check means,* Fargo, North Dakota, 1984.

	Range	Mean
Sucrose %	90 - 102	97
Root Yield	61 - 106	83
Purity %	99 - 102	100

*Checks: Ultramono, Beta 1443, KW 1132, Beta 1230, Bush Johnson 19, and Beta 1237.

SELECTION FOR SUGARBEET ROOT MAGGOT RESISTANCE

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1984 marked the beginning of a program aimed at identifying and developing sugarbeet breeding lines that will provide commercially useful levels of sugarbeet root maggot resistance (SBRM). This effort was previously under the direction of J. C. Theurer at Logan, Utah (2). Selected germplasm has been transferred to Fargo and will provide the basis for the program in the Red River Valley. Eight populations, six commercial hybrids, and 16 pair-crosses from low damage roots selected at Kimberly, Idaho in 1983 were evaluated near St. Thomas, North Dakota in 1984. The site has been utilized for SBMR evaluations the past few years and provided a relatively high uniform population of maggots. The six commercial hybrids evaluated were Beta 1230, KW 1132, Ultramono, ACH 164, ACH 30, and BJ 19. Hybrid mean damage ratings (1) ranged from 3.2 to 3.3, a non-significant difference. These hybrids were tested in a Latin Square. The analysis indicated that infestation and damage ratings were uniform throughout the test area.

Each pair-cross entry was replicated three times. Damage ratings ranged from 2.8 to 3.2, compared to 3.5 for the ACH 30 check. All experimental entries showed significantly less damage than ACH 30. This material had extremely low vigor, making it difficult to obtain optimun stands and suggesting that further inbreeding should be avoided, to the extent possible.

The eight populations screened included five from Logan, Utah that had previously been selected for SBMR resistance and three that were different representations of the world collection. Approximately 600 roots from each population were observed for SBRM damage and superior individuals were saved for propagation. Four of the five previously selected populations were noticeably less damged than the adjacent KW 1132 check. The remaining selected population showed more damage but was still superior to KW 1132. Roots showing less damage than their immediate neighbors were saved for future testing from the three "world collection" populations. The frequency of roots with minimal damage was low in these three populations.

No population or experimental line appeared to be immune to SBRM. The observed levels of SBRM resistance are not adequate for commercial production. Future research will attempt to increase the level of resistance in these materials and look for additional sources of resistance, perhaps in species related to sugarbeet.

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SUGARBEET RESEARCH

1984 Report

Section E

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Doney, D. L. and J. C. Theurer. Potential of breeding for ethanol fuel in sugarbeet. Crop Sci. 24:63-464. 1984.

Saunders, J. W. and M. E. Daub. Shoot regeneration from hormone - autonomous callus from shoot cultures of several sugarbeet (Beta vulgaris L.) Genotypes. Plant Science Letters 34:219-223. 1984.

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FIELD EVALUATION OF EXPERIMENTAL HYBRIDS

J. C. Theurer, J. W. Saunders, and G. J. Hogaboam

Three sets of experimental hybrids were evaluated in 1984 at the B&B Research Farm near Saginaw, MI for yield and quality. Aphanomyces root rot readings were made on some of the hybrids in the greenhouse during the winter of 1983-84. Rhizoctonia ratings were made at East Lansing, and leaf spot ratings were made in disease nurseries at East Lansing and at Beltsville, MD.

B&B Farm

Planting Dates: Experiment 842 and 848-May 2, 1984
Experiment 844-May 9, 1984

Thinning Dates: June 14-20, 1984

Fertilizer: 125 # per acre of 46-0-0 Urea with fall plowdown, and 130 #/acre 9-47-0 + 3% magnesium and 1% Boron, side dressed approximately 1 inch to the side and 1 inch below the seed with the beet drill at time of planting.

Herbicides: Pre-emergence: 3 qt. Pyramin + 2 qt. Antor + 5 1/3 qt. Nortron per acre.
Post emergence: 4 pt. Nortron, 6-2 pt. Betamix and 1.3 pt. H273 per acre.

Fungicides: Applied 10 oz/acre Super-Tin July 7 and Aug. 9 for Rhizoctonia and leaf spot control.

Harvest Dates: October 1-5, 1984
Tops were removed with a triple drum defoliator, and roots were dug using a single row plot harvester. Pressed juice from a 10 beet sample from each plot row was analyzed for sucrose percentage and clear juice purity by the Michigan Sugar Company.

Disease Evaluations

Aphanomyces. Classified on basis of 0=no symptoms to 5=dead plant. Score in tables is in percent of USH20.

Rhizoctonia. Individual plants rated on a scale of 0=healthy to 4=dead plant. Percent diseased shown in tables is a weighted average of individual plant scores.

Leaf Spot. Individual plots were rated on a scale of 0=healthy to 9=dead plant. Average scores per variety are given in the tables.

Experiment:

842 - New Hybrids developed by G. E. Coe at Beltsville, MD. 36 entries, 1-row 28" x 24' plots, 6 replications.

844 - New Hybrids developed by G. J. Hogaboam and J. W. Saunders at East Lansing, MI. 21 entries, 2-row 28" x 24' plots, 6 replications.

848 - New Hybrids of Leaf Spot resistant lines x recent Logan released inbreds and other experimental pollinators. 25 entries, 1 row 28" x 24' plots, 6 replications.

ANALYSIS OF DATA

Data was analyzed by MSTAT Program on IBM-PC computer and tables reflect direct printout of means sorted in decending order for recoverable white sugar per acre. (RWSA).

TABLE 1. Expt. 842. Performance of New Hybrids Developed by G.E. Coe.

21 -10 CMS PARENT
22 -10 O PARENT
23 -10 POLLEN PARENT (A if more than one)
24 -10 POLLEN PARENT B
1 5 RWSA =pounds Recoverable White Sugar per Acre
2 3 T/A X 10 = Tons of roots per Acre X 10
3 4 RWST X 10 = Recoverable White Sugar per Ton x 10
4 4 % SUCROSE X 100
5 4 % CJP X 100 = % Clear Juice Purity x 100
25 3 APHANOMYCES % SCORE (of Check) (0 or blank = no test)
8 3 RHIZOCTONIA PERCENT DISEASED (except 0 = not tested)
13 2 E. LANSING 9-12-84 AVERAGE LEAF SPOT RATING X 10
14 2 BELTSVILLE 9-4-84 AVERAGE LEAF SPOT RATING X 10

CAS NUM.	21	22	23	24	01	02	03	04	05	25	08	13	14
1	1861	12166	80576-0	79620-0	4982	178	2785	1629	9516		55	33	50
2	79626-01	78756-00	6822-0		4282	164	2608	1564	9396	105	77	43	40
3	80320-01	6322-0			4243	170	2490	1510	9346	111	55	37	50
4	80320-01	80576-0	6822-0		4211	164	2570	1535	9422	110	61	33	43
5	6926-01	EL45	6822-0		4114	154	2675	1579	9475	126	53	40	50
6	80320-01	80576-0	82260-0		4047	152	2661	1569	9482	111	69	33	40
7	EL44	EL45	82260-0		3992	143	2789	1623	9546	119	53	47	50
8	81624-01	76590-0	82260-0		3980	145	2747	1614	9497	111	0	30	33
9	78617-01	76590-0	EL40		3954	140	2834	1651	9537	102	68	37	40
10	79626-01	78756-00	82260-0		3919	160	2434	1479	9341	103	58	33	50
11	81624-01	76590-0	EL40		3903	141	2762	1622	9497	105	54	33	43
12	80576-01	76590-0	EL40		3901	138	2819	1636	9561	106	0	40	43
13	6926-01	EL45	EL40		3878	145	2694	1582	9503	124	71	40	50
14	80320-01	82657-0	82260-0		3855	147	2617	1550	9464	119	50	40	33
15	80576-01	LSR			3845	140	2740	1609	9497	106	52	33	30
16	79626-01	78756-00	EL40		3812	142	2684	1594	9440	108	77	47	53
17	78616-01	76590-0	82260-0		3800	140	2711	1590	9507	112	71	30	27
18	80320-01	LSR			3795	150	2547	1527	9402	97	58	33	33
19	EL44	EL45	6822-0		3723	130	2850	1651	9568	124	63	43	50
20	81652-01	76590-0	EL40		3686	135	2730	1599	9514	106	64	33	40
21	80320-01	80576-0	EL40		3611	137	2643	1563	9469	112	0	40	47
22	80320-01	82657-0	6822-0		3565	134	2675	1585	9452	116	56	37	40
23	1861	12166	80576-0	76250-237	3562	128	2787	1626	9531		55	37	33
24	1861	12166	76590-0	EL40	3531	122	2883	1667	9576	112	59	40	50
25	6926-01	EL45	82260-0		3421	133	2556	1529	9414	124	65	40	50
26	80576-01	76590-0	82260-0		3406	122	2796	1623	9559	119	52	30	30
27	GWE4				3344	119	2794	1643	9488	124	48	37	57
28	1861	12166	76590-0	6822-0	3342	120	2799	1630	9539	117	65	40	43
29	80576-01	6322-0			3333	123	2694	1587	9484	110	62	33	30
30	EL44	EL45	EL40		3324	116	2863	1661	9559	118	51	50	60
31	78616-01	76590-0	EL40		3316	120	2794	1624	9551	106	62	33	40
32	81624-01	76590-0	6822-0		3307	122	2700	1596	9465	110	49	27	37
33	80320-01	82657-0	EL40		3262	120	2713	1607	9454	110	53	47	43
34	80576-01	76590-0	6822-0		3189	113	2829	1645	9547	119	58	27	33
35	USH23				3010	111	2706	1592	9492		60	40	53
36	81561-01	76590-0	EL40		2983	107	2761	1616	9515	113	67	40	40
	MEAN				3706	137	2263	1597	9489		60	37	43
	LSD .05				1046	38	123	56	71		NS	9	8

TABLE 2. Experiment 844. Performance of New East Lansing Experimental Hybrids.

21 -10 CMS PARENT
22 -10 O PARENT
23 -10 POLLEN PARENT (A if more than one)
24 -10 POLLEN PARENT B
1 5 RWSA =pounds Recoverable White Sugar per Acre
2 3 T/A X 10 = Tons of roots per Acre X 10
3 4 RWST X 10 = Recoverable White Sugar per Ton x 10
4 4 % SUCROSE X 100
5 4 % CJP X 100 = % Clear Juice Purity x 100
8 3 RHIZOCTONIA PERCENT DISEASED (except 0 = not tested)
13 2 E. LANSING 9-12-84 AVERAGE LEAF SPOT RATING X 10
14 2 BELTSVILLE 9-4-84 AVERAGE LEAF SPOT RATING X 10

CAS NUM.	21	22	23	24	01	02	03	04	05	08	13	14
37	81B40X02	EL45			4677	178	2635	1552	9493	57	50	50
38	81B40X02	82B10-00			4208	173	2440	1476	9370	56	40	43
39	GW E4				4081	145	2825	1659	9491	57	43	37
40	US H23				4055	148	2748	1611	9507		43	50
41	80576-01	82B10-00			4054	154	2655	1559	9507	46	33	30
42	US H20				3867	143	2703	1581	9535	52	53	53
43	81624-01	82B10-00			3839	149	2586	1508	9372	46	40	43
44	81624-01	EL45			3794	143	2656	1573	9461	40	40	43
45	6926-01	82B10-00			3788	153	2490	1488	9427	50	40	47
46	82B63X01		J523-510+	J534-51	3788	148	2565	1522	9459	45	37	33
47	76590-01	82B10-00			3662	136	2701	1587	9502	61	33	30
48		82B10-00			3641	144	2536	1514	9429	55	40	37
49	82B70X01		J523-510+	J534-51	3641	142	2579	1519	9498	55	33	30
50	82B64X01		J523-510+	J534-51	3639	141	2596	1541	9453	66	33	27
51	82B61X01	EL45			3617	139	2596	1533	9482	54	43	43
52	82B11X2		J523-510+	J534-51	3491	137	2570	1531	9438	37	30	30
53	EL44	82B10-00			3294	121	2714	1581	9547	53	43	53
54	80576-01	EL45			3254	119	2735	1591	9552	61	37	37
55	6926-01	EL45			2877	110	2632	1543	9519	47	50	50
56	76590-01	EL45			2347	85	2759	1596	9586	55	37	43
57	EL44	EL45			2118	78	2732	1591	9548	56	60	63
	MEANS				3787	146	2606	1543	9465	57	40	40
	LSD .05				706	26	114	58	67	NS	9	9

TABLE 3. Experiment 848. Performance of Leaf Spot Resistant X Logan Inbreds.

21 -10 CMS PARENT
22 -10 O PARENT
23 -10 POLLEN PARENT (A if more than one)
1 5 RWSA =pounds Recoverable White Sugar per Acre
2 3 T/A X 10 = Tons of roots per Acre X 10
3 4 RWST X 10 = Recoverable White Sugar per Ton x 10
4 4 % SUCROSE X 100
5 4 % CJP X 100 = % Clear Juice Purity x 100
13 2 E. LANSING 9-12-84 AVERAGE LEAF SPOT RATING X 10

CAS NUM.	21	22	23	01	02	03	04	05	13
58	C16	EL45		6427	264	2442	1500	9285	57
59	FC607		L10	6199	237	2613	1552	9446	47
60	EL44	EL45	L11	6107	233	2625	1564	9428	63
61	US H23			6067	237	2576	1541	9410	43
62	C16		L19	6065	234	2604	1573	9354	57
63	GW E4			5905	223	2661	1581	9442	43
64	28C6		L56	5837	220	2665	1576	9465	57
65	L53	FC606		5773	221	2612	1551	9449	60
66	EL44		L11	5752	233	2482	1516	9309	63
67	FC606		L10	5626	220	2564	1518	9471	50
68	FC607		L19	5605	200	2813	1675	9413	50
69	FC606		L19	5479	200	2747	1647	9384	50
70	SP73747	C16		5261	214	2461	1487	9370	40
71	EL44	EL45	L57	5208	208	2503	1496	9423	53
72	EL44	EL45	73100-04	5198	202	2570	1542	9394	43
73	FC607		L56	5043	185	2734	1608	9491	50
74	FC606		L57	4843	190	2552	1512	9468	60
75	C16	FC606		4808	191	2524	1507	9426	50
76	L20	L33		4805	192	2489	1499	9384	60
77	EL44	EL45	L38	4778	189	2521	1524	9358	57
78	FC607	C456		4773	194	2463	1491	9360	50
79	FC606		L38	4544	184	2475	1500	9353	47
80	C563	FC606		4488	178	2529	1520	9392	47
81	FC607		L50	4192	157	2661	1568	9488	50
82	FC606		L50	4146	157	2623	1546	9490	57
	MEAN			5317	206	2580	1544	9410	52
	LSD .05			1101	44	115	48	83	11

EVALUATION OF GREENHOUSE ROOT WEIGHT ± ROOT/BLADE RATIO SELECTION

J. Clair Theurer

In 1981 a study was initiated at Logan, Utah to evaluate the merit of greenhouse selection of 40-50 day old plants for high root weight + high root/leaf blade weight ratio (TLWR) in the highly heterogeneous population of sugarbeet, AE08. Seeds were planted at the three-quarter inch depth in vermiculite in 6-inch diameter white pots. Upon emergence plants were thinned to a single seedling per pot. Pots were burried in a sand bench to expose only one-half inch of pot above the sand surface. The sand surrounding the pots was kept in a moist condition and the pots were rotated from left to right and front to rear twice/week to maintain as constant environment as possible. Plants were continually illuminated with a bank of fluorescent lights placed 30 inches above each bench giving a light intensity of approximately 200 uE. Each plant received 50 ml of Snyder's nutrient solution daily. There were 120 pots/bench on two benches, and four serial plantings were made resulting in a total of 480 plants sampled from the population. After 40-45 days growth, each plant was harvested and separated by hand into tap root, petiole and leaf blades and immediately weighed. Approximately 8% of the plants with large root weight (greater than 1.0 s.d. above the mean) plus a high root/leaf blade weight ratio (greater than 1.5 s.d. above the mean) were selected for seed increase. After photothermal induction eight plants with greater than 2.0 s.d. above the mean for both root weight and R/B ratio were crossed as pairs. AE08 R/B (2) and AE08 R/B (3) were two of these pair crosses that were evaluated In field trials. The balance of the plants that survived photothermal induction were planted in an isolated garden plot with four CMS lines to produce hybrids.

A field planting of the parent population, selection progenies, and CMS hybrids was made at the B&B Research Farm at Saginaw, Michigan in 1983 and 1984. Individual field plots consisted of 2 rows, 28 inches apart and 24 feet long. Two commercial varieties USH23 and HH33 were included as checks in 1983 and USH23 was used as a check in 1984. There were six replications in each experiment each year. All beets in a plot were harvested for root yield and samples of pressed juice from duplicate 10-beet samples of each entry were analyzed for sucrose content and clear juice purity by Michigan Sugar Co. In 1984, four representative beets from each plot were separated into roots, petioles and blades and immediately weighed. Root/blade weight ratios were calculated for each entry.

In another 1984 experiment we evaluated the yield and sugar content of EL40 vs EL46 and compared similar CMS hybrids, to three CMS lines, (EL44xEL45), L53, and C16. Seed of the hybrids was produced at Logan in 1982-83 overwinter tent increase units. Plot size, harvest procedures, etc. were essentially the same as indicated above for the AE08 experiments.

EL46 was released in 1979 as a seed increase of the three highest TLWR lines after several cycles of phenotypic recurrent selections by F. W. Snyder and G. J. Hogaboam. Selection EL46 was significantly better than Low TLWR selections in sucrose percentage and clear juice purity percentage, but not in plot weight. Comparitive performance of High TLWR with the parent line, EL40 was not made.

Results and Discussion

A brief resume of 1983 evaluation of population AE08, selections, and hybrids was made in the 1983 research report. However, when computer problems were realized last year, the data was hurriedly analyzed to meet the report deadline. Several errors were found when the data was carefully reanalyzed using MSTAT on our IBM-PC computer. Thus a more complete and corrected set of data for 1983 is given in Table 1. AE08 R/B (1) and AE08 R/B (2) were significantly higher (respectfully 12% and 14%) in recoverable white sugar per acre (RWSA) and in root yield. The two selections were equal in RWSA to USH23, the highest yielding check variety. AE08 R/B (3) showed no difference from the parent population even though it was a pair cross selected for greater than 2 s.d. above the mean for both root weight and R/B ratio. There were no significant differences between AE08 and the R/B selections for sucrose percentage, or clear juice purity percentages. However, AE08 R/B (3) showed a tendency towards lower sucrose and lower CJP percentages.

Hybrids with C16 CMS comparing AE08 to AE08 R/B (1), showed no difference for any character measured. AE08 R/B (1) crossed to FC606 CMS had 15% more RWSA and root weight compared to FC606 CMSxAE08 parent population. The sucrose percentage and clear juice purity were similar for the two hybrids.

Comparative performance data for the 1984 field evaluation of AE08 and selections is given in Table 2. The parent population showed higher values for each character measured, compared to the R/B selections. AE08 R/B (3) had significantly lower RWSA, root weight, RWST, sugar percentage and CJP percentage than AE08 or AE08 R/B (1). Hybrids of C16 CMS and FC606 CMS with AE08 R/B (1) showed a trend for higher RWSA, root weight, and RWST compared to CMS x parent hybrids. CMSxAE08 hybrids had slightly higher sucrose percentage.

TABLE 1. Comparative Sugar Yield, Root Weight, Sucrose Percentage and Clear Juice Purity Percentage for AE08 versus AE08 R/B and Hybrids Saginaw, MI 1983.

	RWSA[1] Lbs	Root wt. T/Acre	RWST[2] Tons	Sucrose %	CJP[3] %
AE08	5441	22.2	245.1	14.9	93.5
AE08 R/B (1)	6120	25.2	243.7	14.8	93.3
AE08 R/B (2)	6240	25.2	248.3	14.9	94.1
AE08 R/B (3)	5336	22.7	235.1	14.5	92.7
FC606xAE08	5522	21.6	256.1	15.2	94.7
FC606xAE08 R/B (1)	6355	25.0	253.9	14.9	94.6
C16xAE08	5723	23.0	249.7	15.1	93.7
C16xAE08 R/B (1)	5717	24.2	235.9	14.3	93.7
USH23	6281	23.4	268.4	15.8	95.1
HH33	5807	22.4	260.2	15.2	95.5
MEAN	5854	23.5	249.6	15.0	94.1
LSD .05	588	2.2	10.7	0.6	0.6
CV	8.7	3.7	8.2	3.2	0.6

1/ RWSA = Recoverable white sugar per acre
2/ RWST = Recoverable white sugar per ton
3/ CJP = Clear juice purity percentage

The fresh weight R/B ratio of entries at harvest is shown in column 6 of Table 2. AE08 R/B (1) had significantly higher R/B ratio than the AE08 parent and AE08 R/B (3) had almost twice the value of that of AE08 R/B (1). Hybrids with FC606 CMS showed similar partitioning while the C16xAE08 parent hybrid had a significantly higher ratio than the C16xAE08 R/B (1) cross.

Marked differences in performance were noted between years. The 1984 growing season was a dry year with very little precipitation during the summer, particularly during the month of August. Plots of AE08 R/B (3) showed wilting during afternoons to the extent that this particular entry could be easily visually recognized in each replication. Yield data and wilting observation suggest that selections for high R/B may have an adverse yield response under moisture stress conditions. This

effect may be because of the apparent decrease of fibrous roots associated with high R/B ratios or that metabolic processes of the R/B selections have been altered so that plants do not perform as well under moisture stress. Zielke (Personal communication) has observed similar wilting effects with other R/B selections. AE08 R/B (3) had a very high R/B ratio and yet yield performance was less than the parent population. This suggests that selection passed the threshold for optimum beneficial effect on yield for this pair cross. Comparison of AE08 R/B (2) vs AE08 R/B (3) in 1983 also demonstrates that plants selected for high root weight + high R/B ratio are not the same genetically since each was a pair cross of two plants having both root weight and R/B ratio exceeding 2 s.d. above the mean.

TABLE 2. Comparative Sugar Yield Root Weight, Sucrose Percentage, Clear Juice Purity Percentage and Root/Blade Weight Ratio for AE08 Versus AE08 R/B and Hybrids - Saginaw, MI, 1984.

	RWSA[1] Lbs	Root Wt. T/Acre	RWST[2] Tons	Sucrose %	CJP[3] %	Fresh Wt.R/B Ratio
AE08	4939	18.5	272.4	16.2	94.3	5.37
AE08 R/B (1)	4667	17.8	261.6	15.7	93.8	6.78
AE08 R/B (3)	3506	14.4	244.3	15.1	92.5	11.04
FC606xAE08	4771	18.0	257.6	15.8	94.4	5.87
FC606xAE08 R/B (1)	5410	20.6	250.1	15.6	94.7	5.65
C16xAE08	4554	17.8	266.7	15.6	93.6	6.45
C16xAE08 R/B (1)	5659	22.7	263.2	15.1	93.6	5.41
USH23	4985	18.3	273.5	16.0	95.2	5.25
MEAN	4817	18.5	261.1	15.6	94.0	6.48
LSD .05	793	3.2	8.8	0.4	0.6	0.80
CV	14.0	14.8	2.9	2.0	0.5	10.6

1/ RWSA = Recoverable white sugar per acre
2/ RWST = Recoverable white sugar per ton
3/ CJP = Clear juice purity percentage

Data for the comparative performance of EL40 and EL46, and hybrids is given in Table 3. EL40 had significantly higher RWSA and root weight than EL46, but was not different for RWST, sucrose percentage or CJP percentage. EL46 hybrids were no different than similar EL40 hybrids for any of the five performance characteristics measured. The R/B ratios were consistently but non-significantly higher for EL46 and EL46 hybrids compared to EL40 and EL40 hybrids.

TABLE 3. Comparative Sugar Yield, Root Weight, Sucrose Percentage, Clear Juice Purity Percentage and Root/Blade Weight Ratio for EL40 Versus EL46 and Hybrids - Saginaw, MI 1984.

	RWSA[1]/ Lbs	Root Wt. T/Acre	RWST[2]/ Tons	Sucrose %	CJP[3]/ %	Fresh Wt.R/B Ratio
EL40	3518	12.2	288.8	16.8	95.3	5.42
EL46	2836	9.8	286.7	16.6	95.6	6.13
(EL44xEL45)xEL40	4743	16.0	296.4	17.2	95.3	5.88
(EL44xEL45)xEL46	5101	17.6	290.5	16.9	95.4	6.52
L53xEL40	4270	14.6	293.6	17.1	95.4	6.50
L53xEL46	4713	16.1	294.1	17.1	95.5	7.03
C16xEL40	5182	18.6	276.5	16.2	95.0	5.28
C16xEL46	4813	17.5	274.9	16.2	94.7	6.27
MEAN	4397	15.3	287.7	16.4	95.3	6.13
LSD .05	573	2.1	10.8	0.5	0.5	1.09
CV	11.1	11.8	3.2	2.7	0.4	15.10

1/ RWSA = Recoverable white sugar per acre
2/ RWST = Recoverable white sugar per ton
3/ CJP = Clear juice purity percentage

A study reported in 1987 (See Research Report p B12) on another population, 6F3, showed no differences in root yield but slightly higher sucrose content for the R/B selection vs the parent. Hogaboam also observed no difference in root hield but significantly greater sucrose and clear juice purity in high TLWR vs low TLWR hybrids of selections made from EL40. Two other populations studied at Logan in 1979, and 1980 showed no difference from the parental line. Summarizing data from several experiments we can conclude that R/B selection is effective in some populations but not in others. Also, R/B selections have better yield performance in years when precipitation is normal or above average, than they do under moisture stress conditions.

EVALUATION OF "SOIL FREE" SELECTIONS IN MICHIGAN - 1984

J. C. Theurer and G. E. Coe

In 1968, G. E. Coe began a breeding and selection program to develop "soil free" beets. Beginning with Demmings white globe beets, he made four successive crosses to some of the best sugarbeet lines available in the early 70's and then made subsequent recurrent selection of the best "soil free" progenies for several years. Sugar content was low at first, but it has been increased 0.7% thru selection. At Beltsville the "soil free" selections have shown equal or better leaf spot resistance to GWE4 or USH20.

In 1984, twenty five of the best "soil free" progenies were evaluated at the B&B Research Farm near Saginaw, Michigan. Three inbred lines that had been selected at Logan for smooth roots with no root suture and few root hairs, and the two commercial varieties USH23 and GWE4 were included in the experiment for comparison. Individual field plots consisted of 2 rows, 28 inches apart and 24 feet long. Each entry was planted in a randomized block experiment of six replications. At harvest, replicates 1, 3, and 5 were dug by hand, free soil was shaken from each root, they were topped, and placed in a harvest box. Replicates 2, 4, and 6 were machine harvested with our single row plot harvester. Tops were removed with a triple drum defoliator just prior to harvest. Machine harvested beets passed over the single "kicker" unit and were elevated to a harvest box, but were not allowed to pass over the grab rolls. All adhering soil was removed by hand from each root and the weight of clean roots was determined for each plot. A ten beet sample was utilized to obtain pressed juice for Lab analysis. Sugar content and clear juice purity were determined by the Michigan Sugar Co.

Results

The "soil free" beet experiment was harvested the second week of October near the end of harvest for all of our research experiments at the B&B Farm. The soil was relatively dry and all roots harvested in agronomic as well as this experiment were relatively clean and free of adhering soil. Differences between the "soil free" beets and the check varieties were non-significant (Tables 1 & 2, column 9). However, six of the "soil free" entries harvested by hand had less than half the soil per ton as the checks. Had we made our harvest the last of October or the first part of November after rainfall, differences mainifest by the "soil free" beets may have been greater. Some of the progenies showed considerable within plot root variation for the amount of root hairs, depth of sutures and sprangled tips.

In other progenies roots were uniformly smooth and of excellent symetrical shape. The "soil free" selections in general had root weight and purity equal to the commercials (Tables 1 & 2). They were significantly lower in sucrose percentage.

Dr. Coe will make crosses of some of the better progenies with higher sugar lines during the winter of 1984-1985, in an effort to increase the sucrose content of the "soil free" selections. The excellent symetrical smooth root shape of these selections and their root yield preclude that additional research should be continued on this material. Comparison of "soil free" versus present commercial varieties needs to be made on different soil types, and during a more normal harvest season when there is more moisture in the soil than we experienced in 1984.

TABLE 1. Performance of Hand Harvested "Soil Free" Sugarbeet Progenies at B&B Research Farm, Saginaw, MI - 1984.

15 -10 SEED OR LOT NUMBER
22 -10 PEDIGREE
1 5 RWSA = pounds Recoverable White Sugar per Acre
2 3 T/A X 10 = Tons of roots per Acre x 10
3 4 RWST x 10 = Recoverable White Sugar per Ton x 10
4 4 % SUCROSE X 100
5 4 % CJP X 100 = % Clear Juice Purity x 100
21 3 POUNDS SOIL PER TON OF BEETS HARVESTED

CAS NUM.	1 5	2 2	0 1	0 2	0 3	0 4	0 5	2 1
128	GW E4		6482	213	3060	1775	9539	184
129	US H23		6254	221	2830	1677	9440	154
130	29H1+a	SMOOTH RT	4319	163	2647	1596	9362	91
131	29H3	SMOOTH RT	2757	129	2142	1371	9116	58
132	29F23	SMOOTH RT	3404	134	2550	1565	9279	54
133	8350-9	SOIL FREE	5090	211	2412	1449	9406	91
134	8350-13	SOIL FREE	6207	240	2581	1540	9425	128
135	8350-15	SOIL FREE	6079	234	2602	1552	9426	149
136	8350-19	SOIL FREE	6023	242	2511	1516	9365	64
137	8350-37	SOIL FREE	6560	244	2699	1598	9456	143
138	8350-38	SOIL FREE	5384	201	2673	1573	9491	174
139	8350-47	SOIL FREE	5390	215	2516	1531	9326	68
140	8530-82	SOIL FREE	6057	227	2669	1572	9491	67
141	8350-83	SOIL FREE	6116	251	2440	1477	9364	78
142	8350-99	SOIL FREE	6351	266	2385	1445	9362	78
143	8350-118	SOIL FREE	5706	223	2567	1539	9401	185
144	8350-126	SOIL FREE	5755	223	2579	1535	9441	128
145	8350-131	SOIL FREE	5139	200	2573	1530	9444	107
146	8350-134	SOIL FREE	6032	237	2564	1527	9437	121
147	8350-139	SOIL FREE	5844	216	2697	1538	9488	168
148	8250-6	SOIL FREE	5902	228	2592	1522	9516	69
149	8250-24	SOIL FREE	5081	193	2618	1557	9440	83
150	8250-36	SOIL FREE	5682	210	2710	1601	9467	139
151	8250-40	SOIL FREE	5631	211	2665	1571	9486	156
152	8250-105	SOIL FREE	6077	229	2651	1573	9450	161
153	8250-108	SOIL FREE	5348	199	2682	1594	9438	154
154	8250-126	SOIL FREE	6571	245	2685	1595	9440	92
155	8250-139	SOIL FREE	6252	229	2737	1602	9516	201
156	8250-144	SOIL FREE	6713	251	2679	1587	9457	73
157	8250-150	SOIL FREE	7530	287	2631	1542	9521	79
	MEAN		5724	219	2612	1557	9426	116
	LSD .05		982	41	156	64	154	NS

TABLE 2. Performance of Machine Harvested "Soil Free" Sugarbeet Progenies, B&B Research Farm, Saginaw, MI 1984.

21 -10 SEED OR LOT NO.
22 -10 PEDIGREE
12 5 POUNDS RECOVERABLE WHITE SUGAR/ACRE (RWSA)
8 3 TONS/ACRE X 10
11 4 POUNDS RECOVERABLE WHITE SUGAR/TON (RWST) X 10
4 4 PERCENT SUCROSE X 100
7 4 PERCENT CLEAR JUICE PURITY X 100
20 3 POUNDS SOIL PER TON OF BEETS HARVESTED

CAS NUM.	2 1	2 2	1 2	0 8	1 1	0 4	0 7	2 0
241	GW E4		5816	201	2884	1680	9534	16
242	US H23		5526	201	2744	1610	9502	14
243	29H1+a	SMOOTH RT	4474	178	2521	1524	9359	18
244	29H3	SMOOTH RT	2131	101	2136	1412	8961	32
245	29F23	SMOOTH RT	3461	141	2467	1505	9320	24
246	8350-9	SOIL FREE	4772	186	2563	1517	9471	11
247	8350-13	SOIL FREE	5673	222	2553	1515	9457	11
248	8350-15	SOIL FREE	5676	217	2610	1534	9508	17
249	8350-19	SOIL FREE	5577	228	2459	1474	9411	15
250	8350-37	SOIL FREE	6260	231	2711	1583	9532	13
251	8350-38	SOIL FREE	5495	209	2626	1560	9444	15
252	8350-47	SOIL FREE	5341	212	2508	1499	9425	17
253	8530-82	SOIL FREE	4962	196	2527	1483	9524	11
254	8350-83	SOIL FREE	5192	209	2482	1474	9463	15
255	8350-99	SOIL FREE	5607	235	2391	1453	9345	11
256	8350-118	SOIL FREE	4678	193	2408	1431	9467	11
257	8350-126	SOIL FREE	5370	208	2584	1505	9561	15
258	8350-131	SOIL FREE	4638	183	2525	1498	9462	13
259	8350-134	SOIL FREE	5348	208	2577	1531	9448	20
260	8350-139	SOIL FREE	6024	227	2648	1568	9462	22
261	8250-6	SOIL FREE	5872	225	2609	1540	9481	19
262	8250-24	SOIL FREE	5046	191	2636	1562	9457	17
263	8250-36	SOIL FREE	5442	203	2673	1566	9517	16
264	8250-40	SOIL FREE	4406	174	2532	1484	9534	18
265	8250-105	SOIL FREE	5614	215	2616	1550	9461	10
266	8250-108	SOIL FREE	4083	156	2599	1556	9405	17
267	8250-126	SOIL FREE	5356	202	2647	1558	9494	11
268	8250-139	SOIL FREE	5330	202	2640	1568	9446	16
269	8250-144	SOIL FREE	5920	229	2598	1528	9502	7
270	8250-150	SOIL FREE	5730	220	2604	1538	9477	12
	MEAN		5161	200	2569	1527	9448	15
	LSD .05		1303	50	156	76	103	NS

DEVELOPMENT OF MARKERS AND GENETIC STOCKS OF SUGARBEET

J. C. Theurer

The recently (1982) published book "Maize for Biological Research" edited by William F. Sheridan has the following quote on page 37:

"It is the extensive genetic and cytogenetic data, including both mapped and unmapped loci, along with the availability of a rich and extensive collection of genetic markers and cytogenetic stocks that, together with its favorable biological traits, results in maize being the flowering plant of choice for molecular studies. These features, of course, also make it well suited for cellular and developmental studies."

Logically, we will follow the research on maize and other crops and endeavor to adapt some of the new evolving techniques in future sugarbeet improvement. At present, however, there are few markers or special genetic stocks available for this research. Two approaches are under way at East Lansing at present: 1) studies with cytoplasmic male sterility, including development of special CMS genetic marker stock, and 2) determining the inheritance and linkage association of as many sugarbeet genetic factors as possible to enlarge our knowledge regarding sugarbeet linkage groups.

CMS in crop plants appears to be associated with mitochondrial DNA (mt DNA) (Lever and Gray, 1982, Review). Examples are: Zea mays. (Pring & Levings 1978), Sorghum bicolor (Pring et al. 1982, Condie et al 1982). Powling (1981, 1982) and Powling and Ellis (1983) postulated that cytoplasmic male sterility in sugarbeet is also associated with mt DNA as has been found in corn and sorghum. Their research involved only the Owen source of CMS. Other potentially different sources have not been studied by biochemical techniques.

In 1984 we continued the development of isolines of eight potentially different CMS sources, some of which are at the BC_3 - BC_4 generation. Plans were made to characterize four of these by restriction endonuclease digestion techniques this year. However, the acceptance of another position and resignation by the Post Doctoral Research Associate working in this area, deferred this research to a later date. F_1 crosses were made of 12 new male sterile segregates from the NC7 Ames collection of Beta. These will be evaluated in the 1984-85 greenhouse.

F_1 crosses and steckling have been produced to determine the inheritance of six characters. The causal factors for the variation of the trout gene (Tr) and the association of trout (Tr) and colored leaf (Cl) are being studied.

PROSPECTS FOR GENETIC TRANSFORMATION THROUGH SUGARBEET TISSUE CULTURE

Joseph W. Saunders

Considerable interest has developed around the regeneration of plants from callus cells in crop species because of the crucial role this procedure has in moving new genetic variation from the cell level to the whole plant level. Tobacco remains the model system for these genetic manipulations. In most dicotyledonous crop species where this capacity is well demonstrated, it is really a matter of adventitious shoot development from callus that required both an auxin and a cytokinin for growth. Roots are induced on these shoots by transfer to a medium with an auxin but without a cytokinin.

Sugarbeet callus has been grown on what can be called conventional auxin and cytokinin media in many laboratories. Shoots have been reported, but apparently not in reliable frequencies. In the combinations of genotype by growth regulators that we have observed in our program, this conventional callus has been dark and dense, and no shoots observed. By serendipity we observed quite a different type of callus growing from leaves of some shoot cultures after several months. This white friable callus proved capable of rapid growth on basal medium, that is, inorganic salts, vitamins and sucrose but without either an auxin or a cytokinin. This hormone-autonomous growth is quite unconventional, but in its lack of hormone requirement is similar to callus strains that have been reported in numerous other species, as well as to tumor tissue from several species.

Although beet callus of this type doesn't require a cytokinin suchas benzyladenine (BA) to grow, BA in the range 0.1-3.0 mg/l will induce shoot formation. Some shoots appear with what looks like a hypocotyl, and their origin may be from somatic embryogenesis. We've been putting the shoots through a cleanup step on shoot culture medium prior to inducing roots on them and potting them up.

The capacity to form the callus is found in germplasm from throughout the species Beta vulgaris. Buds or better developed shoots have been produced in some individual genotypes from most of these sources. Six diverse monogerm sources gave as a whole much better shoot formation than four multigerm sugarbeet and four multigerm non sugarbeet sources.

The most likely application of this technique is the introduction of new genes into the beet genome by use of the Ti plasmid from the crown gall pathogen bacterium, Agrobacterium tumefaciens. Engineered plasmids have been developed in some labs that carry genes into tobacco or petunia genomes attached to other genes that code for antibiotic resistance. Leaf disc cells can be genetically transformed by exposing them to A. tumefaciens containing the plasmid engineered to include an antibiotic resistance gene alongside the donor gene. By placing such leaf discs on media containing the antibiotic as well as shoot inducing hormone concentrations, only cells transformed by the plasmid will grow and yield shoots. The promoter sequence that leads this new gene sequence into transcription and subsequent phenotypic expression is essentially constitutive, that is, turned on all the time. Until the intricacies of tissue specific gene expression are either understood by science or overcome by recombination and natural mutation, all introduced genes will probably have to be expressed in all cells.

What genes are the most likely candidates for transfer into the sugarbeet? If important genes or alleles already existing in Beta could be isolated, they could be moved into adapted elite genetic backgrounds. Or put back as additional copies into the donor genotype to intensify phenotypic expression. Disease resistance alleles come to mind for this application.

Genes from other species moved into sugarbeet could present problems of expression in what would be a strange regulatory background. The bottleneck may turn out to be choosing and isolating beneficial genes from other species.

I think the best candidates for inclusion into the sugarbeet genome at present are microbial genes encoding catabolic (degradative) enzymes for secondary metabolites found in harvested roots. These metabolites represent crystalization problems and carbon nitrogen sinks, and it is thought that the plant could tolerate less betaine and raffinose, for example.

How soon can these genes be inserted into the sugarbeet genome? As soon as the plasmids are engineered by the molecular biologists.

SUGARBEET RESEARCH

1984 Report

Section F

Field Crops Laboratory, Plant Genetics and Germplasm Institute, Beltsville Agricultural Research Center-West, Beltsville, Maryland

Gerald E. Coe, Research Geneticist

Cooperation:

Michigan Agricultural Experiment Station

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CONTENTS

Breeding Sugarbeets for Resistance to Black Root and Leaf Spot

G. E. Coe

Research work on sugarbeets at the Agricultural Research Center, Beltsville, Maryland is directed toward improvement of sugarbeet germplasm resistant to Aphanomyces black root and Cercospora leaf spot, important diseases in eastern United States. Much effort is now directed toward producing germplasm with "soil-free" taproots to eliminate mechanical cleaning and for possible use in commercial transplanting operations. In addition, research and development is being conducted to produce: 1) germplasm with resistance to southern root rot (Sclerotium rolfsii) for use in southern United States where this disease is endemic; 2) germplasm combining high root tonnage with reasonable sucrose percentage for fuel alcohol production; and 3) germplasm with a low content of nonsucrose solubles.

Testing for Leaf Spot Resistance

The usual fine leaf spot epidemic was obtained at Beltsville in 1984. Results of the 1984 leaf spot nursery tests are presented in Table 1.

TABLE 1. Results of Beltsville leaf spot tests in 1984

Description	No. Breeding Lines Tested	Av. Leaf Spot Rating*			
		Breeding Lines	USH20	E4	Resistant Check
Beltsville MM BRR-LSR Lines	55	3.2	5.2	--	2.2
Low NSS MM Lines	22	4.6	6.3	--	2.5
E. Lansing mm Lines	40	3.2	6.0	5.0	2.6
Soil-free MM Lines	68	3.5	5.0	--	2.3
Soil-free mm Lines	34	3.3	5.2	--	2.3
Suscept. MS X Resist. PF	6	5.2	5.7	--	2.7
Resist. MS X Resist. PF	21	3.9	5.7	--	2.7
Resist. MS X Very Resist. PF	2	3.2	5.7	--	2.7
Late Planting					
Soil-free MM Lines	33	3.6	5.3	4.0	2.8
E. Lansing mm Lines	70	2.8	5.5	4.2	2.5

*Leaf Spot Scale: 0 = No Spots; 10 = All leaves dead.

Among sugarbeets that have a high degree of resistance (Leaf spot readings from 2.0 to 2.8 in the 1984 Beltsville Nursery) it is very difficult to determine which plants might have even better resistance (leaf spot reading of 1.0 to 1.5). As a result, it is quite difficult to develop breeding lines with a rating of 2.0 or less even in a severe epidemic, especially when you consider that every sugarbeet plant develops some spots. Several of the East Lansing monogerm progenies had leaf spot ratings of 2.0, but it wasn't possible with the visual ratings we make to determine if one was better than the others. Perhaps more detailed examination could separate the most resistant progeny and the most resistant plants within a progeny. Note in Table 1 that the Beltsville black root and leaf spot resistant multigerms had good resistance (Av. 3.2) as did the 2 hybrids having resistant male-sterile lines crossed to our very resistant multigerm pollinator (Av. 3.2). It should also be noted that Mono Hy E4 (one of the more resistant commercial hybrids) was less resistant than our breeding lines and experimental hybrids. It should also be noted that USH20 has less resistance than Mono Hy E4. At the time it was originally produced, USH20 was considered to have a reasonable amount of resistance. The conclusion 3 or 4 years ago that additional leaf spot resistance in the breeding lines is not a pressing matter was a correct one. While leaf spot resistance should not be completely ignored, emphasis is now being put on sucrose percentage and yield.

Testing for Black Root Resistance

Several conditions make it difficult to determine precisely how much progress has been made in improving resistance to black root disease. As resistance has been increased, it has been necessary to increase the severity of the disease epidemic. With the more severe epidemics, it was necessary to use resistant check varieties with more resistance; and disease ratings are comparative ones based on the resistance exhibited by check varieties. Also it is not possible with our facilities to precisely control the severity of the disease epidemic from experiment to experiment. If the epidemic is rather mild, the tested lines appear to have relatively more resistance than if the epidemic is severe. (The disease rating of the susceptible check is a "barometer" of the severity of the epidemic.) Hence, the estimate of progress in improving resistance to black root is more subjective than scientific. The results of the 1983-84 Beltsville black root tests are presented in Table 2.

The groups of progenies on the first 3 lines in Table 2 have average resistance equal to the resistant check. This means that many of the lines had resistance better than the resistant check. (The resistant checks in the tests this year have slightly more resistance than any used previously.) It is encouraging that we have such good resistance to both leaf spot and black root in the breeding lines listed in line 3 of Table 2. The soil-free multigerm lines listed on the fourth line of table 2 haven't as much resistance to black root as one would expect after having had 4 crosses to resistant sugarbeets. Probably the intense selection for the desirable root characteristics is a selection mainly for genes from the garden beet parent which wasn't resistance to black root. In the case of the F2 progenies from the sugarbeet X fodderbeet crosses (lines 5 and 6 in table 2) there is slightly greater resistance in the descendants of the sugarbeet mothers than in the descendants of the fodderbeet mothers. Any exhibited tolerance came from the sugarbeet parent of these crosses, since the fodderbeets had no selection for black root resistance.

TABLE 2. Results of Testing 1983 seed production for black root resistance

Description	No. Lines Tested	Av. Black Root Rating*		
		Tested Lines	Resistant Check	Susceptible** Check
MM from Black Root Selection***	95	99	100	106
MM from Leaf Spot Selection***	34	100	100	106
MM progenies from an extremely leaf spot resistant plant	24	98	100	116
MM "Soil-free" progenies	64	114	100	120
F2 progenies from sugarbeet X fodderbeet	27	108	100	115
F2 progenies from fodderbeet X sugarbeet	19	112	100	114

*126 = Death of all plants; 70 = No infection
**Susceptible check has only slightly less resistance than USH20
***These lines are resistant to both black root and leaf spot.

Selecting for Resistance to Southern Root Rot

New information was obtained on hypocotyl diameter of seedlings and its effects on interpreting the results of the greenhouse southern root rot (Selerotium rolfsii) tests. Very early (1981) in testing for resistance to this disease we discovered that seedlings with large hypocotyl diameters at the time of inoculation had a physical advantage in surviving the disease epidemic. New evidence indiates that as seed ages it takes longer for seedlings to reach a particular hypocotyl size and vitality. Hence, if you are testing seed of breeding lines produced this year in the same test with seed produced the previous year, the newer seed has a built-in hypocotyl-size advantage in resisting southern root rot. (Seed storage conditions at Beltsville are poor. If seed is stored under good conditions, such as found in Colorado, perhaps there would be very little difference between 6 month old seed and 18 month old seed in the rate of seedling development.) An experiment was conducted to determine if the same lines placed in successive tests in the same year would produce seedlings with hypocotyls of the same size relative to one another. Results of this experiment are presented in Table 3.

Although the correlation between the hypocotyl diameters is significant at the 5% level, there are enough differences to have some effect on the apparent disease resistance. Eleven of 12 breeding lines tested in successive years exhibited a significant decrease in hypocotyl diameter the second year in comparison with the check variety (Table 4).

The hypocotyl diameter from the 2 years also had a nonsignificant correlation of r = .388. Ten of the 12 lines appeared to have less resistance to southern

TABLE 3. Sugarbeet seedlings hypocotyl diameters in 2 successive experiments

Seed No.	Hypocotyl Diameters in % of check	
	Experiment 1	Experiment 2
8322-4	110	104
8322-5	102	108
8322-6	104	103
8322-7	102	105
8322 -9	109	108
8322-10	115	108
8322-11	115	110
8322-12	113	110
8322-13	100	110
8322-14	104	99
8322-15	110	97
8322-16	113	106
8322-17	117	119
8322-18	120	118
8322-19	106	105

r = .551*

root rot when tested the second year. This is partially related to the decreased size of the hypocotyl, but other factors could also be influencing the observed apparent resistance. Three of the lines appearing to have resistance in the first year of testing (8222-10, 8222-116, and 8322-22 in Table 4) appeared to be somewhat susceptible when tested the 2nd year. In spite of the factors complicating the testing technique and an accurate assessment of the amount of progress being made, there are several indications that resistance is being increased. First, the disease rating of some of the progenies of third cycle selections compared to unselected check lines (all seed being produced in the same year) exhibit more tolerance to the disease than lines with only 1 cycle of selection. Second, three-fourths of the lines from selected plants have more or at least as much resistance as the unselected line. Third, seed increases of progenies with the best resistance produce descendants with obvious resistance. Fourth, resistant seedlings transplanted to the nursery for taproot production survived with less rotting in 1984 than in previous years.

TABLE 4. Results of testing sugarbeet lines in 2 successive years.

Seed Number	Disease Rating		Hypocotyl Diameter	
	1st Year	2nd Year	1st Year	2nd Year
8222-10	97	117	112	98
8222-23	89	93	100	102
8222-40	91	93	108	98
8222-047	76	100	117	102
8222-50	82	97	107	88
8222-63	89	83	127	104
8222-65	89	92	119	90
8222-72 1/2	78	99	104	93
8222-115	92	99	126	105
8222-116	85	108	117	94
8322-12	98	91	113	104
8322-22	77	107	108	91

F for Disease Ratings = 11.08**
F for Hypocotyl Diameter = 27.92**
r for Disease Rating = -.12 NS
r for Hypocotyl Diameter = .388 NS

Development of Soil-Free Sugarbeet Taproots

"Soil-free" sugarbeets were tested at Beltsville and at East Lansing in 1984. The Beltsville results (Table 5) indicate that there is almost no change from the results of the previous year.

TABLE 5. Harvest data of soil-free roots in the 1984 Beltsville late planted nursery

Variety	Leaf Spot Rating	Root Weight T/A	Sucrose %	Non-sucrose Solubles %	RJAP* %
Mono Hy E4 (Check)	4.0	16.48	15.47	3.16	83.01
USH20 (Check)	5.3	14.01	14.33	2.73	83.99
Soil-free MM (Av. of 33 progenies)	3.6	16.15	13.65	2.43	84.89

*RJAP = Raw Juice Apparent Purity

In general the root yield was low because of the late planting date. However, both the root yield and sucrose percentage of USH20 were depressed relatively more than the other lines because of its susceptibility to leaf spot. The average root yield of the soil-free lines is only 1/2 ton less than Mono Hy E4, but the sucrose is 1.82 percentage points less. On the other hand, the nonsucrose solubles of the soil-free lines is considerably less than Mono Hy E4 resulting in a 1.88 percentage points higher raw juice apparent purity. Selected roots from the soil-free lines averaged 3/4 lb. heavier per root and averaged .18 percentage point higher in sucrose content compared to the 8 root samples sugar samples from these same lines. Because of the low sucrose content, the selected roots are being crossed to the highest sucrose content root selections we have. With regard to freedom from adhering soil there are still differences from one progeny to the next and within progenies. Some roots are lifted with practically no adhering soil, while a few have almost as much soil as roots of USH20. It will, however, be necessary to get the sucrose content up to acceptable levels, before the soil-free characteristic is "perfected".

Twenty-five progenies previously tested at Beltsville were tested at the B&B farm in Michigan. See the report of J. Clair Theurer in this issue.

Recovered "soil-free" monogerm lines were planted at Beltsville in 1984. Yield data was not taken but leaf spot readings were made and selected roots were compared with selected monogerm roots from an adjacent experiment. These data are presented in Table 6.

TABLE 6. Selected soil-free monogerm roots in the 1984 Beltsville nursery

Description	No. Roots Tested	Average of Selected Roots				
		Leaf Spot Rating	Root Weight	Sucrose	Non-Sucrose Solubles	RJAP*
			lbs.	%	%	%
Mono Hy E4	None	5.00	--	--	--	--
USH23	None	5.67	--	--	--	--
"Soil-Free" monogerm	153	3.78	3.35	12.07	2.41	83.36
Usual type monogerm	66	3.17	3.31	13.50	2.64	83.64

*RJAP = Raw Juice Apparent Purity

The performance of the soil-free monogerms puts them in the approximately the same stage of development as the soil-free multigerms. The one attribute that makes them unacceptable is the low sucrose content. As a group they are not quite as free of soil as the multigerms, but some individuals are almost as soil-free as the best soil-free multigerms.

Sugarbeet X Fodderbeet Breeding

The F2 generation of the sugarbeet X fodderbeet crosses and their reciprocals were planted in the 1984 Beltsville nursery in 4-row strips for selection purposes only. It was unfortunate an experiment wasn't planned to determine

per acre sugar yield, because at harvest it was obvious that root production was at least 20 to 25 percent more than any sugarbeets. (A small yield trial is planned for 1985.) It was also observed that stands in some of the F2 lines from fodderbeet X sugarbeet crosses were rather poor giving the remaining plants an advantage in moisture and nutrients. The F2 lines from the sugarbeet X fodderbeet crosses had excellent stands. Analyses of the selected roots are presented in Table 7.

The leaf spot resistance of all these hybrids is better than USH23. Selected roots from the F2 lines in fodderbeet cytoplasm are larger than selected roots of the reciprocal. However, this has been influenced somewhat by their thin stands. The selected roots from the F2 lines are much larger than the selected sugarbeet roots from the adjoining experiment. The sugar percentage in the F2 lines in sugarbeet cytoplasm is considerable higher than their reciprocals. Again this has been influenced somewhat by their better stands. The average sugar percentage of the F2 lines in the 83803-n group (derived from the sugarbeet side of the cross) is only .25 percentage point lower than average of the sugarbeet lines from the adjoining experiment. When the effect of root size on percent sucrose is considered, 83803-n may actually be genetically superior to the sugarbeets in the adjacent experiment in sucrose percentage. This breeding material appears to have good potential, greatly exceeding our expectations.

Testing for Low Content of Nonsucrose Solubles

A nursery test was conducted in 1984 to compare 8 progenies of roots selected for average content of nonsucrose solubles. The results of this test were disappointing. There was no difference between the 2 groups of progenies in percent nonsucrose solubles. There seemed to be an association between high root weight and low percentage of nonsucrose solubles. The correlation was r = -.174 which was not significant at the 5% level according to Fischer's T test. To be significant r must = -.225. However, there may well be some negative relationship between root size and the percent of nonsucrose solubles.

TABLE 7. Data on F2 lines from sugarbeet X fodderbeet crosses and the reciprocals

F2 Group No	A2*	Seed No.	Av. Leaf spot Rating	Black Root Resistance: Av. of Tested Lines	Black Root Resistance: Susc. Check	No. Lines Tested	No. Roots Tested	Av. Root Weight	Av. Sucrose	Av. NSS**	Av. RJAP***
								lbs	%	%	%
--	SB	USH23	5.33	No test	--	1	None	--	--	--	--
1	SB	83800-n	3.50	113	117	12	29	4.63	12.99	2.17	85.69
	FB	83801-n	3.40	110	116	13	44	5.25	10.98	2.79	79.74
2	SB	83803-n	3.31	104	113	12	30	4.91	13.28	2.47	84.32
	FB	83802-n	3.25	112	113	3	5	6.28	12.90	2.43	84.15
3	SB	83900-n	4.25	102	110	3	11	5.40	10.51	3.08	77.34
	FB	83901-n	4.58	110	110	3	10	6.56	8.72	2.88	75.17
	SB	Av. of Adjoining Sugarbeet Experiment	3.31	No test	--	15	66	3.31	13.50	2.64	83.64

*A2 = Maternal Grandparent: SB = sugarbeet; FG = fodderbeet
**NSS = Non-sucrose Solubles
***RJAP = Raw Juice Apparent Purity